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No. 2,609.] *FRIDAY, NOVEMBER 21, 1902.* [*Vol. LI.*

ONE-HUNDRED-AND-FORTY-NINTH SESSION, 1902-1903.

SESSIONAL ARRANGEMENTS.

The Opening Meeting of the One-hundred-and-Forty-Ninth Session was held on Wednesday Evening, the 19th of November, when an Address was delivered by Sir William Henry Preece, K.C.B., F.R.S., Chairman of the Council.

For meetings previous to Christmas the following arrangements have been made :—

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock :—

November 26.—Dr. Gustave Goegg, Professor of Technology at the High School of Commerce, Geneva, "Le Tunnel du Simplon, et la nouvelle ligne de Chemin de fer directe Anglo-Italienne pour l'Orient." (In French.) Sir William H. Preece, K.C.B., F.R.S., Chairman of the Council, will preside.

DECEMBER 3.—ALFRED WATKINS, "Some Aspects of Photographic Development." SIR WILLIAM ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., will preside.

" 10.—CLOUDESLEY BRERETON, "French Rural Education and its Lessons for England." LORD REAY, G.C.S.I., G.C.I.E., Chairman of the London School Board, will preside.

" 17.—ARCHIBALD P. HEAD, Mem.Inst.C.E., "The South Russian Iron Industry." Mr. WILLIAM EGERTON HUBBARD will preside.

INDIAN SECTION.

Thursday Afternoon, at 4.30 o'clock:—

DECEMBER 11.—MISS ELLA C. SYKES, "Domestic Life in Persia." EARL PERCY, M.P., will preside.

Papers for Meetings after Christmas:—

PROF. W. SMART, LL.D., "Industrial Trusts." SIR ROBERT GIFFEN, K.C.B., LL.D., F.R.S., will preside.

ARTHUR KITSON, "Oil Lighting by Incandescence."

A. SONNENSCHEIN, "The Metric System."

DIXON H. DAVIES, "The Cost of Municipal Trading."

PERCY MACQUOID, "Stage Costumes and Accessories."

G. F. BODLEY, R.A., "The Principles of Applied Art."

CHARLES HOLME, "Modern Movements in Decorative Art."

HENRY WALKER, Commissioner of Lands, British North Borneo, "British North Borneo."

HARVEY DALZIEL, "Three Colour Printing."

B. W. GINSBURG, LL.D., "The Port of London."

JERVOISE A. BAINES, C.S.I., "The Indian Census."

HERBERT M. BIRDWOOD, C.S.I., LL.D., "The Province of Sind."

THE COUNTESS OF ABERDEEN, "Women in Canada."

SIR CHARLES JAMES LYALL, K.C.S.I., C.I.E., "The Province of Assam."

INDIAN SECTION.

The meetings of this Section will take place on Thursday Afternoons, at 4.30 o'clock:—

December 11, January 22, February 26, March 12, April 23, May 14.

COLONIAL SECTION.

The meetings of this Section will take place on Tuesday Afternoons, at 4.30 o'clock:—

January 13, February 10 (5 o'clock), March 31, May 5.

APPLIED ART SECTION.

The meetings of this Section will take place on Tuesdays, at 4.30 or 8 o'clock:—

January 20, February 3, 17, March 17, April 21, May 19.

CANTOR LECTURES.

The following Courses of Cantor Lectures will be delivered on Monday Evenings, at 8 o'clock:—

PROF. VIVIAN B. LEWES, "The Future of Coal Gas and Allied Illuminants." Four Lectures. November 24, December 1, 8, 15.

LECTURE I.—NOVEMBER 24.—The effect of the last twenty years on the manufacture of coal gas—High illuminating power *versus* low-grade gas—The methods available for the economic production of low-grade gas—The effect of temperature on carbonisation.

LECTURE II.—DECEMBER 1.—The dilution of coal gas by gases cheaply produced by other processes—The effect of lowering candle power on the calorific value of the gas—The photometry of low-grade gas and the conditions under which its illuminating power is best developed.

LECTURE III.—DECEMBER 8.—The relation of the candle-power and calorific value of gas to its use with the incandescent mantle—The incandescent mantle and the directions in which it will be improved—The probable future of coal gas.

LECTURE IV.—DECEMBER 15.—Lighting by oil and the advances of the past fifty years—The use of oil in incandescent mantle lighting—Vapour burners and their future—Air gas and its latest developments—The present position and future of acetylene.

JULIUS HÜBNER, "Paper Manufacture." Four Lectures.
February 2, 9, 16, 23.

PROF. J. A. FLEMING, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." Four Lectures.
March 2, 9, 16, 23.

W. WORBY BEAUMONT, Mem.Inst.C.E., "Mechanical Road Carriages." Four Lectures.
April 27, May 4, 11, 18.

JUVENILE LECTURES.

Two lectures suitable for a juvenile audience will be delivered on Wednesday evenings, December 31 and January 7, at five o'clock, by Professor EDWARD B. POULTON, M.A., D.Sc., F.R.S. (Hope Professor of Zoology in the University of Oxford), on "Means of Defence in the Struggle for Life among Animals."

LECTURE I.—DECEMBER 31.—"The Methods by which Animals hide in order to escape their Enemies and catch their Prey."

LECTURE II.—JANUARY 7.—"The Ways in which Animals warn their Enemies and signal to their Friends."

CONVERSAZIONE.

The Annual Conversazione of the Society will probably be held on Tuesday, June 30, 1903. Each member is entitled to a card for himself, and one for a lady.

PROCEEDINGS OF THE SOCIETY.

CHARTER.—THE SOCIETY OF ARTS was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of the Arts, Manufactures, and Commerce of the Country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade, and to the riches and honour of the kingdom; and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, or Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department of science in connection with the Arts, Manufactures, and Commerce of this country."

THE SESSION.—The Session commences in November, and ends in June.

ORDINARY MEETINGS.—At the Wednesday Evening Meetings during the Session, papers on subjects relating to inventions, improvements, discoveries, and other matters connected with the Arts, Manufactures, and Commerce of the country are read and discussed.

INDIAN SECTION.—This Section was established in 1869, for the discussion of subjects connected with our Indian Empire. Six or more Meetings are held during the Session.

COLONIAL SECTION.—The Section was formed in 1874 under the title of the African Section, for the discussion of subjects connected with the Continent of Africa. It was enlarged in 1879, so as to include the consideration of subjects connected with our Colonies and Dependencies. Four or more Meetings are held during the Session.

APPLIED ART SECTION.—This Section was formed in 1886, for the discussion of subjects connected with the industrial applications of the Fine Arts. Six or more Meetings are held during the Session.

CANTOR LECTURES.—These Lectures orginated in 1863, with a bequest by the late Dr. Cantor. There are several Courses every Session, and each course consists generally of from two to six Lectures.

ADDITIONAL LECTURES.—Special Courses of Lectures are occasionally given.

JUVENILE LECTURES.—A Short Course of Lectures, suited for a Juvenile audience, is delivered to the Children of Members during the Christmas Holidays.

ADMISSION TO MEETINGS.—Members have the right of attending the above Meetings and Lectures. They require no tickets, but are admitted on signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor and other Lectures. Books of tickets for the purpose are supplied to the Members, but admission can be obtained on the personal introduction of a Member. For the Juvenile Lectures special tickets are issued.

JOURNAL OF THE SOCIETY OF ARTS.—The *Journal*, which is sent free to Members, is published weekly, and contains full Reports of all the Society's Proceedings, as well as a variety of information connected with Arts, Manufactures, and Commerce.

EXAMINATIONS.—Examinations, founded in 1853, are held annually by the Society, through he agency of Local Committees, at various centres in the country. They are open to any person. The subjects include the principal elements of Commercial Education, and Music. Full particulars of the Examinations can be had on application to the Secretary.

LIBRARY AND READING-ROOM.—The Library and Reading-room are open to Members, who are also entitled to borrow books.

CONVERSAZIONI are held, to which Members are invited, each Member receiving a card for himself and a lady.

MEMBERSHIP.

The Society numbers at present between three and four thousand Members. The Annual Subscription is Two Guineas, payable in advance, and dates from the quarter-day preceding election; or a Life Subscription of Twenty Guineas may be paid. There is no Entrance Fee.

Every Member whose subscription is not in arrear is entitled .—

- To be present at the Evening Meetings of the Society, and to introduce two visitors at such meetings, subject to such special arrangements as the Council may deem necessary to be made from time to time.
- To be present and vote at all General Meetings of the Society.
- To be present at the Cantor and other Lectures, and to introduce one visitor.
- To have personal free admission to all Exhibitions held by the Society at its house in the Adelphi.
- To be present at all the Society's *Conversazioni*.
- To receive a copy of the weekly *Journal* published by the Society.
- To the use of the Library and Reading-room.

Candidates for Membership are proposed by Three Members, one of whom, at least, must sign on personal knowledge; or are nominated by the Council.

All subscriptions should be paid to the Secretary, Sir Henry Trueman Wood, and all Cheques or Post-office Orders should be crossed "Coutts and Company," and forwarded to him, at the Society's House, John-street, Adelphi, London, W.C.

HENRY TRUEMAN WOOD, *Secretary.*

CALENDAR FOR THE SESSION.

The following is the Calendar for the Session 1902-1903. It is issued subject to any necessary alterations:—

NOVEMBER, 1902.

1	S	
2	**S**	
3	M	
4	Tu	
5	W	
6	Th	
7	F	
8	S	
9	**S**	
10	M	
11	Tu	
12	W	
13	Th	
14	F	
15	S	
16	**S**	
17	M	
18	Tu	
19	W	Opening Meeting of the Session
20	Th	
21	F	
22	S	
23	**S**	
24	M	Cantor Lecture I. 1
25	Tu	
26	W	Ordinary Meeting
27	Th	
28	F	
29	S	
30	**S**	

DECEMBER, 1902.

1	M	Cantor Lecture I. 2
2	Tu	
3	W	Ordinary Meeting
4	Th	
5	F	
6	S	
7	**S**	
8	M	Cantor Lecture I. 3
9	Tu	
10	W	Ordinary Meeting
11	Th	Indian Section
12	F	
13	S	
14	**S**	
15	M	Cantor Lecture I. 4
16	Tu	
17	W	Ordinary Meeting
18	Th	
19	F	
20	S	
21	**S**	
22	M	
23	Tu	
24	W	
25	Th	Christmas Day
26	F	*Bank Holiday*
27	S	
28	**S**	
29	M	
30	Tu	
31	W	Juvenile Lecture I.

JANUARY, 1903.

1	Th	
2	F	
3	S	
4	**S**	
5	M	
6	Tu	
7	W	Juvenile Lecture II.
8	Th	
9	F	
10	S	
11	**S**	
12	M	
13	Tu	Colonial Section
14	W	Ordinary Meeting
15	Th	
16	F	
17	S	
18	**S**	
19	M	
20	Tu	Applied Art Section
21	W	Ordinary Meeting
22	Th	Indian Section
23	F	
24	S	
25	**S**	
26	M	
27	Tu	
28	W	Ordinary Meeting
29	Th	
30	F	
31	S	

FEBRUARY, 1903.

1	**S**	
2	M	Cantor Lecture II. 1
3	Tu	Applied Art Section
4	W	Ordinary Meeting
5	Th	
6	F	
7	S	
8	**S**	
9	M	Cantor Lecture II. 2
10	Tu	Colonial Section
11	W	Ordinary Meeting
12	Th	
13	F	
14	S	
15	**S**	
16	M	Cantor Lecture II. 3
17	Tu	Applied Art Section
18	W	Ordinary Meeting
19	Th	
20	F	
21	S	
22	**S**	
23	M	Cantor Lecture II. 4
24	Tu	
25	W	Ordinary Meeting
26	Th	Indian Section
27	F	
28	S	

MARCH, 1903.

1	**S**	
2	M	Cantor Lecture III. 1
3	Tu	
4	W	Ordinary Meeting
5	Th	
6	F	
7	S	
8	**S**	
9	M	Cantor Lecture III. 2
10	Tu	
11	W	Ordinary Meeting
12	Th	Indian Section
13	F	
14	S	
15	**S**	
16	M	Cantor Lecture III. 3
17	Tu	Applied Art Section
18	W	Ordinary Meeting
19	Th	
20	F	
21	S	
22	**S**	
23	M	Cantor Lecture III. 4
24	Tu	
25	W	Ordinary Meeting
26	Th	
27	F	
28	S	
29	**S**	
30	M	
31	Tu	Colonial Section

APRIL, 1903.

1	W	Ordinary Meeting
2	Th	
3	F	
4	S	
5	**S**	
6	M	
7	Tu	
8	W	
9	Th	
10	F	Good Friday
11	S	
12	**S**	Easter Sunday
13	M	*Bank Holiday*
14	Tu	
15	W	
16	Th	
17	F	
18	S	
19	**S**	
20	M	
21	Tu	Applied Art Section
22	W	Ordinary Meeting
23	Th	Indian Section
24	F	
25	S	
26	**S**	
27	M	Cantor Lecture IV. 1
28	Tu	
29	W	Ordinary Meeting
30	Th	

MAY, 1903.

1	F	
2	S	
3	**S**	
4	M	Cantor Lecture IV. 2
5	Tu	Colonial Section
6	W	Ordinary Meeting
7	Th	
8	F	
9	S	
10	**S**	
11	M	Cantor Lecture IV. 3
12	Tu	
13	W	Ordinary Meeting
14	Th	Indian Section
15	F	
16	S	
17	**S**	
18	M	Cantor Lecture IV. 4
19	Tu	Applied Art Section
20	W	Ordinary Meeting
21	Th	
22	F	
23	S	
24	**S**	
25	M	
26	Tu	
27	W	Ordinary Meeting
28	Th	
29	F	
30	S	
31	**S**	Whit Sunday

JUNE, 1903.

1	M	*Bank Holiday*
2	Tu	
3	W	
4	Th	
5	F	
6	S	
7	**S**	
8	M	
9	Tu	
10	W	
11	Th	
12	F	
13	S	
14	**S**	
15	M	
16	Tu	
17	W	
18	Th	
19	F	
20	S	
21	**S**	
22	M	
23	Tu	
24	W	Annual General Meeting
25	Th	
26	F	
27	S	
28	**S**	
29	M	
30	Tu	*Conversazione*

The chair will be taken at Eight o'clock at each of the Ordinary Meetings, and the Cantor Lectures.

The Meetings of the Indian Section and the Colonial Section will commence at Half-past Four o'clock.

The Meetings of the Applied Art Section will be held at Half-past Four or Eight o'clock.

The Annual General Meeting will be held at Four o'clock.

The Juvenile Lectures will be given at Five o'clock.

Notices.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Monday afternoon, 17th inst. Present:—Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., in the chair; L. Ashburner, C.S.I., Horace Bell, Sir George Birdwood, K.C.I.E., C.S.I., M.D., H. M. Birdwood, C.S.I., LL.D., Everard R. Calthrop, F. C. Danvers, T. W. Holderness, C.S.I., Col. Sir Thomas Holdich, K.C.I.E., C.B., J. D. Rees, C.I.E., H. Luttman-Johnson, Carmichael Thomas, Sir Raymond West, K.C.I.E., W. Martin Wood, with Sir Henry Trueman Wood, Secretary of the Society, and S. Digby, Secretary of the Section.

The arrangements for the Session were considered.

APPLIED ART SECTION COMMITTEE.

A meeting of the Committee of the Applied Art Section was held on Tuesday afternoon, 18th inst. Present:—Sir George Birdwood, K.C.I.E., C.S.I., in the chair; Lewis F. Day, Lazenby Liberty, John Sparkes, H. H. Statham, F.R.I.B.A., Carmichael Thomas, Sir John I. Thornycroft, F.R.S., with Sir Henry Trueman Wood, Secretary of the Society, and Henry B. Wheatley, Secretary of the Section.

The arrangements for the Session were considered.

Proceedings of the Society.

FIRST ORDINARY MEETING.

Wednesday, November 19, 1902; SIR WILLIAM HENRY PREECE, K.C.B., F.R.S., Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Aldrich, Orlando Wesley, M.A., D.C.L., LL.D., Ph.D., Room 11, Wesley Block, Columbus, Ohio, U.S.A.
Allen, F. Bowen, M.A., B.Sc., Director, School of Mines, Coolgardie, Western Australia.
Armstrong, M. F., 8, Upper Wimpole-street, W.
Aronson, Adolph, 39, Foster-lane, E.C.
Bandinel, J. J. Frederick, B.A., Newchwang, North China.
Barr, Mark, 25, Kensington-court-gardens, W.
Beauchamp, Earl, K.C.M.G., Madresfield-court, Malvern Link.
Beck, Isaac, M.I.Mech.E., Haymarket-chambers, 17, Haymarket, Sheffield.
Begbie, Ernest, De Beers Consolidated Mines, Ltd, P.O. Box 195, Salisbury, Rhodesia, South Africa.
Behr, H. C., The Consolidated Gold Fields of South Africa, Limited, P.O. Box 1167, Johannesburg, Transvaal, South Africa.
Bensusan, S. L., M.Inst.M.M., Equitable-building, Sydney, Australia.
Bhatt, Parvatiprasad Vishvanath, 55, Blenheim-crescent, Notting-hill, W.
Body, John Benjamin, M.Inst.C.E., Puente de Alvarado 15, Mexico City.
Bose, S., Deputy Superintendent, Central Jail, Jubbulpore, India.
Bostwick, H. R., Messrs. Collbran and Bostwick, Seoul, Korea.
Bott, John, 37, Herne-hill, S.E.
Bower, Edw. H. M., Port Office, Calingapatam, Ganjam District, India.
Brebner, Captain Charles William, Villa des Roses, Rose-hill, Mauritius.
Brelich, Henry, A.R.S.M., care of Messrs. Arnhold, Karberg and Co., Hankow, China.
Browne, Hon. John E. D., The Neale House, The Neale, co. Mayo, Ireland.
Brownell, Clarence Ludlow, 21, Hermitage-road, Richmond, Surrey.
Budge, Edward Barnard, B.Sc., M.Am.Soc.C.E., Engineer in Chief, 1st Section, Chili State Railways (F. C. del E.), Estacion Bella Vista, Valparaiso, Chili, South America.
Bullen, William Henry Chambers, 15, St. John's-road, Richmond, Surrey.
Burt, George Stephen, F.S.S., 4, Lothbury, E.C.
Butcher, Charles Ernest, 273, Finchley-road, South Hampstead, N.W.
Buxton, John Henry, Senr., Clumber-cottage, Montague-road, Felixstowe, Suffolk.
Campbell, David B., 112, Clifton-park Avenue, Belfast.
Carolis, W. D., 18, Kayman's-gate, Colombo, Ceylon.
Chapman, Walter William, F.S.S., 5, Claremont-road, Tunbridge Wells.
Chetty, Rao Saheb T. Namberumal, B.A., 144-5, China Bazaar-street, Sowcarpett, Madras, India.
Close, Henry Gaskell, 101, Eaton-square, S.W.
Dana, Prof. Charles Edmund, 2013, De Lancey-place, Philadelphia, U.S.A.
Danvers, Ernesto, F.S.S., M.Inst.E.E., 475, Piedad, Buenos Aires, South America.
Das, Hari Das, Raghunathganj, Murshedabad, India.

Davy, Joseph Burtt, Cosmos Club, Washington, D.C., U.S.A., and College of Commerce, University of California, U.S.A.

Daw, Frederick R. Williams, The New Zealand Crown Mines Company, Limited, Karangahake, near Auckland, New Zealand.

Deerhurst, Viscount, Dynes Hall, Halstead, Essex.

De Marillac, Count Ernst, Wynberg, Cape Colony, South Africa.

Desborough, Captain Arthur P. H., R.A., Home Office, Whitehall, S.W.

De Teive e Argollo, Miguel, M.Inst.C.E., San Francisco Railway, Alagoinhas, Bahia, Brazil, South America.

Donnelly, Francis, M.S.Chem.Industry, 335, Hyde-road, Ardwick, Manchester.

Donovan, Fergus, Royal Colonial Institute, Northumberland-avenue, W.C.

Douslin, H. B., Public Works Department, Matabeleland District, Rhodesia, South Africa.

Dunham, Henry V., Casein Company of America, 37, Scheepmakershaven, Rotterdam, Holland.

Edwards, Arthur M., Barncote, Reigate, Surrey.

Ellis, Frederic Richard, F.C.S., 15, Shadwell-road, Bishopston, Bristol.

Etherington, John Francis, Hersham, Surrey.

Fowler, George William, Mossel Bay, Cape Colony, South Africa.

Gheury, Maurice Edmund Joseph, F.P.S., 12, Cressy-road, Hampstead, N.W.

Gilfillan, W. H., Surveyor-General's Department, Pretoria, Transvaal, South Africa.

Gilkison, T. T., Mombasa, East Coast of Africa.

Girouard, Lieut.-Colonel Sir Edouard Percy, K.C.M.G., D.S.O., Johannesburg, Transvaal, South Africa.

Gleed, Richard C., Flodden-house, 21, Flodden-road, S.E.

Goldblatt, D., Cape Town, South Africa.

Goold, William Tom, M.I.Mech.E., Tuthill-house, Lydney, Gloucestershire.

Gray, Robert Whytlaw, 7, Orme-court, W.

Halcrow, James Benjamin, 56, West-side, Wandsworth-common, S.W., and 5, Moorgate-street-buildings, E.C.

Hamilton, John James, 1, Barkston-gardens, S.W.

Hardy, James Henry, The Municipal Technical School, Halifax.

Harper, Edgar Josiah, County-hall, Spring-gardens, S.W.

Harris, Morrie J., Municipal Surveyor, Mafeking, Cape Colony, South Africa.

Hawkesley, Charles, M.Inst.C.E., 30, Great George-street, S.W.

Hawkins, Edward, Manor Estate, Sidcup, Kent.

Henriques, Cecil Quixam, M.I.Mech.E., 59, Sussex-gardens, Hyde-park, W., and 15, Victoria-street, Westminster, S.W.

Heyer, A. E., Rosebank, Cape Town, South Africa.

Hill, Walter Wellesley, Admiralty Harbour of Refuge Works, Peterhead, N.B.

Hilton, Ernest Frederick, 23, The Boltons, South Kensington, S.W., and Constitutional Club, W.C.

Hipwell-Howitt, Arthur George, 2, Studdridge-street, Hurlingham, S.W.

Hke, Saw, Hsipaw Sawbwa Gyi, Hsipaw, Northern Shan States, Burma.

Hoffmann, John J., M.Inst.M.M., Rand Club, Johannesburg, Transvaal, South Africa.

Horne, James Edward, M.A., 8, Earlsfield-road, Wandsworth-common, S.W.

How, Thomas William, 1, Delahay-street, S.W.

Ive, Arthur Fenwick, 85, Montague street, Worthing, Sussex.

Jennings, Sydney J., Messrs. H. Eckstein and Co., P.O. Box 149, Johannesburg, Transvaal, South Africa.

Kelynack, T. N., M.D., M.R.C.P., 53, Harley-street, W.

Kevorkian, Hagop, 3 Victoria-avenue, Bishopsgate-street, E.C.

Kilmer, Frederick B., Messrs. Johnson and Johnson, New Brunswick, New Jersey, U.S.A.

Kimber, Harry Watkins, Messrs. Dick, Kerr and Co., Limited, 110, Cannon-street, E.C.

Knowles, Hugh Charles, Glebe-house, Sherborne-lane, E.C.

Latif, Khan Bahadur Abdul, Bopatla, Kishna District, India.

Leeds, Edward Lambert, The Brown Hoisting Machinery Co., 39, Victoria-street, S.W.

Legg, Hugh G., P.O. Box 358, Cape Town, South Africa.

Le Roux, S. D., P.O. Box 100, Salisbury, Rhodesia, South Africa.

Letcher, John Teague, Truro, Cornwall.

Letcher, Thomas Henry, St. Day, Scorrier, Cornwall.

Lithgow, William T., Kingston Shipbuilding Yard Port Glasgow.

Littlewood, E. T., M.A., B.Sc., Wynberg High School for Boys, Wynberg, Cape Colony, South Africa.

Lonsdale, Earl of, Lowther Castle, Penrith.

Luke, James, 6, Pollock-street, Calcutta.

Lynch, Harry Finnis Bloss, 33, Pont-street, S.W.

Macbean, Edward, Rannochlea, St. Andrew's-drive, Pollokshields, Glasgow.

Mace, Prof. William Harrison, A.M., Ph.D., 127, College-place, Syracuse, New York, U.S.A.

McConnell, John, Lanzi, Campiglia Marittima, Toscana, Italy.

McGregor, John, Maitland, near Cape Town, South Africa.

Marsden, Alfred, A.M.I.Mech.E., Oakley Works, Windsor.

Mokhber-ed-Dowleh, His Excellency (Hossien Goli Khan), K.C.I.E., Teheran, Persia.

Morris, Philip A., Rose Bank, Harrow-view, Harrow.

Murphy, Sir James, Altadore, Blackrock, Dublin

Murray, James P., The Toronto Carpet Manufacturing Co., Limited, Toronto, Canada.

Murray-Morgan, Everard Home, A.I.Mech.E., Briar Lea, Prestatyn, N. Wales.
Naylor, John Alfred, A.M.I.Mech.E., 15, Cromford-road, West-hill, S.W.
Neville, Harry, J.P., Indwe, Cape Colony, South Africa.
Northcroft, G. A., Director of Public Works, Government Offices, Bloemfontein, Orange River Colony, South Africa.
Offen, Charles Rose Witcher, F.S.S., Home for Boys, Cumberland-road, Bristol.
Owtram, B., Chinese Eastern Railway Company, Mining Department, Yen-tai District, New chwang, China.
Paddock, George Harrie, Mill Bank, Wellington. Salop.
Pape, Eric, Farragut-building, Massachusetts-avenue, Boston, Massachussetts, U.S.A.
Parker, Sir Gilbert, D.C.L., M.P., 20, Carlton House-terrace, S.W.
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Peregrino, F. Z. S., *The South African Spectator*, Cape Town, South Africa.
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Pordage, Frederick, Entebbe, Uganda, viâ Mombasa, East Africa.
Quin, Stewart Blacker, 1, Lombard-street, Belfast,
Rana, Brigadier-Col. Kumar Nur Singh, Bahadur, Assoc.Inst.C.E., Superintending Engineer, Khatmandu, Nepal, India.
Rao, P. V. Ranganatha, B.A., B.L., Pudukotah, Native State, South India.
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Seward, Frederick John, East London, South Africa.
Sheridan, René, Bangkok, Siam.
Shipway, Lieut.-Col nel R. W., V.D., Grove-house, Chiswick, W.
Shockley, William Hillman, care of Hongkong and Shanghai Banking Co., Limited, 31, Lombard-street, E.C.
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Smythe, Francis, A.M.Inst.C.E., The Municipal Offices, Finchley, N.
Stead, Alfred, F.R.C.I., Clement's inn, W.C.
Steuart, T. B., Castlegilmour, Sanquhar, N.B.
Sutton, J. R., M.A., Kenilworth, Kimberley, South Africa.
Tays, Eugene Augustus Hoffman, M.Am.S.C.E., Fuerte, Sinaloa, Mexico.
Thomas, Arthur, M.Inst.M.M., Zalamea la Real, Huelva, Spain.
Thomson, A. S., Lodna, Jherria P.O., Bengal, India.
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Walter-Gallagher, J., Bangkok, Siam.
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Wilson, James H. Charnock, F.R.C.I., King's Leigh, Wembley, N.W.
Wood, Frank, Messrs. Foucar and Co., Limited, Rangoon, Burma.
Woodward, Harry Page, J.P., F.G.S., M.Inst.C.E., Moira Colliery, Collis Coal-field, Western Australia, and 129, Beaufort-street, Chelsea, S.W.
Wright, Richard Ernest, Assoc.M.Inst.C.E., Department of Public Works, Port Elizabeth, South Africa.
Yeoman, John Pattison, The Close, Brompton, near Northallerton, Yorkshire.

The CHAIRMAN delivered the following

ADDRESS.

In the address I had the honour of delivering to you on the 20th of November, 1901, I dealt with that division of our Society's functions which embraces Arts and Science. I purpose now to take up Manufactures and Commerce. I then referred to the fact that Huxley regarded the emergence of the philosophy of evolution under the guidance of Darwin as the most portentous event of the 19th century. I pointed out that man has hastened the operations of nature in effecting improvement, for he works directly not only by the selection of the fittest but by the removal of the weakest. This immediate selective and directive modification by human intelligence is strikingly shown by the rapid development of the modern practical applications of science to the wants of man. I ventured also to suggest that by carefully observing the direction of improvement and by determining the motive causes it was even possible to forecast the probable developments of existing applications in the coming century.

I now purpose to apply a somewhat similar process to determine the causes which result in successful or disastrous financial undertakings, and to show that the commercial conduct of industrial processes arising from the practical applications of discoveries follow distinct laws which may be said to constitute a "Science of Business."

In the establishment of any business, or the development of any invention, the first requisite is *capital*, and this capital should be just that amount of money which is necessary for the purpose. It is only fair that an inventor should be recouped for the time, labour, and expense he has incurred in maturing and patenting his invention, but this does not satisfy the average inventor. He wants his reward at once. He wishes to anticipate the future, and his own estimate of the value of his invention is not usually modest. He may not have sufficient credit to secure money from a bank. He must resort to a financier who knows how to float a company and how to secure a handsome profit on the transaction for himself. Thus, the concern is launched on its practical career weighted with a large unproductive capital and hampered at once with a financial incubus. In well managed companies *preliminary expenses* are usually the first item wiped off by profits, so that capital may be entirely productive. The Limited Liability Act of 1862 has much to answer for in the incubation of bogus companies, but the Companies' Act of 1900, which has just come into force, will tend very greatly to minimise the operations of the professional company promoter, to secure interested managers, and to establish working concerns on a better financial position.

The greatest business in the world is, perhaps, that of the British Empire. It has no capital in the proper sense of the word. It has large loans, principally bequeathed to it by our forefathers—the result of wars. Every expenditure—new ships, new guns, new buildings, new works, &c.—is usually charged to revenue. Thus, the annual Budget contains much that in ordinary private enterprises would be charged to capital. If the property of the British Empire, thus established out of revenue, were valued on commercial lines its amount would astonish its owners—the British public.

The laws of business are the results of observation, and are developed by experience. In considering them we have to regard—

1. Revenue and its ratio to Capital.
2. Expenditure and its ratio to Revenue.
3. Allocation of the difference into—
   (*a*) Renewals.
   (*b*) Depreciation.
   (*c*) Reserve.
   (*d*) Redemption of Capital.
   (*e*) Dividends and Bonuses.

No business can continue to be developed without the creation of fresh capital. This can be:

1. Taken from Revenue.
2. Taken from Reserve.
3. Borrowed from the Bank.
4. Subscribed by the Public.

The order is that of desirablity.

A careful consideration of what has been done in this direction in various fields will enable us to generalise some useful conclusions.

I purpose surveying from a broad and general point of view the progress of certain industries with which I have had, more or less, personal experience, and, although I am sorely tempted to unfold several tales that would harrow up your commercial souls, I will refrain from dealing with anything in particular, and confine myself with that which is more instructive, though less exciting.

The industries I select are—

1. Water.
2. Gas.
3. Railways.
4. Telegraphs.
   (*a*) Submarine cables.
   (*b*) Telephones.

I take the best available statistics on each subject, tabulate them and graphically record the results. We are all getting used to curves. The weather reports in the daily papers make us familiar with diagrams. Indeed diagrams are becoming so general that our illustrated papers teem with them, and they have become so understanded of the people that even he that runs may read. In fact, the existence of any general law is always evident when, if we mark well-ascertained facts at regular uniform intervals, these points, when connected together by a continuous line, form a curve. The shape of this curve gives the law. The engineer of to-day thinks not so much in the mathematical language of the Cambridge Tripos as in the graphical or diagramatic language of the line, area or solid.

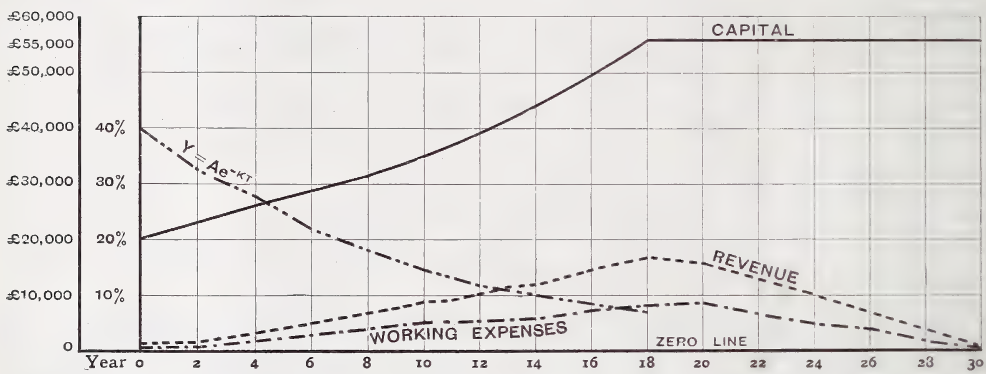
The curve, which proves such a valuable help in estimating the progress and determining the success or failure of business is *the logarithmic curve*. It is in fact the compound interest curve. Whenever a given

proportion is regularly added to or deducted from a known sum of money, or any fixed quantity, at uniform intervals, it can be represented either by an ascending or a descending curve. The rate at which the curve falls depends on what is called the *logarithmic decrement*.

Now when we take such industries as I have indicated above, and graphically record from year to year the relations between capital, revenue, expenditure, and profit, we possess a permanent and continuous diagramatic history of the growth, decay, or conduct of the business. It indicates the changes in time. We have a running view of progress and a clear indication of fall. The signals are as rapid and as certain as those of the barometer in showing changes of weather. They require observant and practical translation. They give us indications of laws. They enable us to forecast and even to prophecy.

and expenditure in a very satisfactory way was closed, and after lingering for 12 years more it was wound up. The logarithmic curve became irregular and impossible in the 18th year and showed that reconstruction or winding up ought to have been applied in its 20th year. The diagram shows also that as soon as we can determine the logarithmic decrement (K in the equation) we can forecast the business in any future period if no price-cutting rival enters the field. On the other hand we may have fresh developments introduced which add new sources of income. The curve may become a straight line. It may even ascend. This is occurring with the modern electric light industry. Fresh markets are opening out in electro-chemistry, heat and power. Power and automobiles are "a potentiality of wealth beyond the dreams of avarice," and certainly beyond the scope of the mathematician.

FIG. 1.



The average growth of business per year is the total increase during any period of years divided by the number of years. The growth would be constant and uniform if the business received equal increments in successive years, but the components of most businesses are variable quantities, and the increase per annum itself is also variable. It is, in fact, in most cases, a diminishing quantity due to the approach to saturation in the possible amount of business attainable. We can represent this growth as a diminishing percentage per annum, and this gives us the descending logarithmic curve.

Fig. 1 is a curve of an imaginary business. It shows that it took two years to be established. It then began to show profit and it flourished steadily for the next 16 years when some new rival industry made inroads into its business. The capital which had been growing with its revenue

I.—WATER.

Water is the oldest of these industries. The New River Company for supplying London with water for drinking purposes, originated with Sir Hugh Myddelton in the reign of James the First—300 years ago. The supply of pure water which is so necessary to the health and comfort of every human being of the community, is essentially the proper function of the municipality, and in the majority of cases it has been carried out by the local authorities. Many companies, however, exist, especially in serving the metropolis. It is, however, not a speculative or competitive business. It is conducted under strict statutory powers. The amount of water supplied varies directly with the population; its income depends on the rateable value of the district; its growth is steady, and its prosperity fixed. There is, however, one branch of it that is

distinctly commercial, viz:—the hydraulic distribution of high pressure water for power purposes in London. The London Hydraulic Power Company was established in 1884, and its whole financial history is given in the diagram, Fig. 2.

The capital now invested is £750,000,

The revenue is £100,000,

The expenditure is £44,000,

The profits are £56,000, and are allocated thus—

Reserve	£5,500
Dividends and Interest	£50,500

Fig. 2.

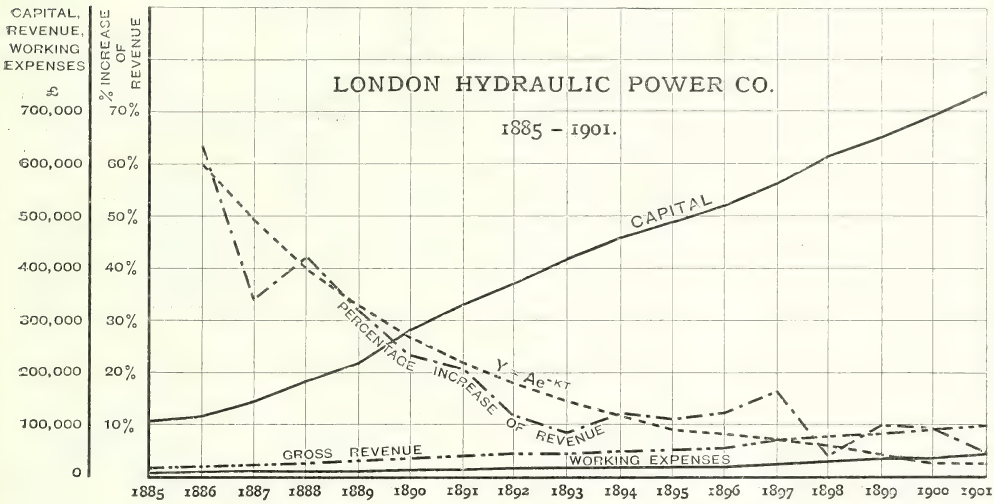
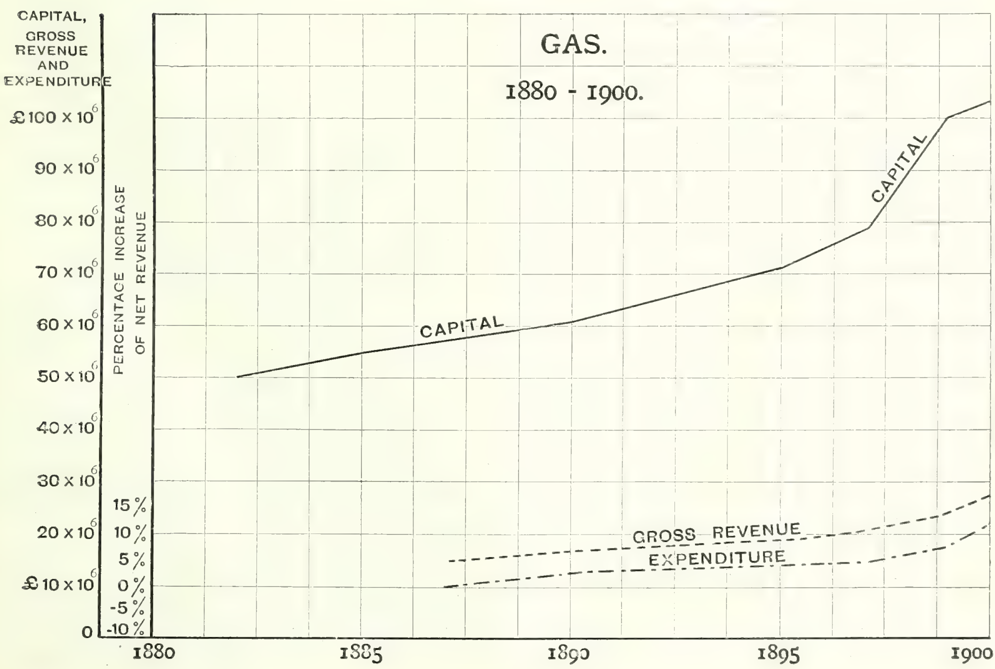


Fig. 3.



The capital is divided thus—

Shares	£580,000
Debentures	120,000
Reserve	50,000
	£750,000

The diagram shows how admirably the business has followed the logarithmic law, how steady has been its progress, and how well its prosperity has been maintained.

illustrates a diminution. Fig. 3 (p. 11) shows this. The business has been too long established to show the logarithmic law, but it shows strange ups and downs in the variations of profit, and remarkable jumps in the increase of capital. The curves show the increased rate of growth in the business since the introduction of the electric light.

The following are the last available statistics of the two big London companies :—

GAS, LIGHT, AND COKE COMPANY.

Year ending December	Capital.	Gross Revenue.	Ratio Revenue to Capital.	Expenditure.	Ratio of Expenditure to Revenue.	Profits.	Ratio of Profits to Revenue.
	£	£	Per cent.	£	Per cent.	£	Per cent.
1896	10,225,000	3,540,779	34·6	2,542,818	71·5	997,961	9·7
1897	10,301,000	3,613,586	35·07	2,613,943	72	999,643	9·65
1898	10,301,000	3,832,013	37·19	2,663,001	70	1,169,012	11·4
*1899	22,685,840	4,161,836	18·3	2,898,941	69	1,262,895	5·6
1900	22,772,650	4,536,944	19·9	3,457,274	76	1,079,670	4·75

* Capital Consolidation Act, 1898.

SOUTH METROPOLITAN COMPANY.

Year ending December	Capital.	Gross Revenue.	Ratio Revenue to Capital.	Expenditure.	Ratio of Expenditure to Revenue.	Profits.	Ratio of Profit to Capital.
	£	£	Per cent.	£	Per cent.	£	Per cent.
1896	5,475,000	1,267,343	23·1	935,149	73·5	332,194	6
1897	5,553,757	1,339,090	24·1	1,002,771	75	336,319	6
1898	6,014,332	1,448,896	24·9	1,068,704	74	380,192	6·3
1899	6,072,971	1,588,817	26·1	1,235,630	77	353,181	5·8
1900	6,219,371	1,985,694	31·9	1,645,408	83	340,286	5·4

II.—GAS.

Gas commenced with the 19th century, and was in a flourishing condition of steady progress and steady indolence arising from great prosperity and fat dividends when electricity appeared as a rival in 1878, and gave its proprietors a very serious fright and a very rough shaking. It is, however, remarkable that electricity has proved the friend and not the enemy of gas. It has created an appetite for more light, and has taught gas managers that if they are to keep their businesses together they must look out for "fresh woods and pastures new." Hence, gas for heating, cooking, and power purposes has been much pushed. The supply of gas has not been checked, but, on the contrary, its rate of growth is actually increasing. The advent of the incandescent mantle has had much to do with this. Not so its profits where the business is in the hands of private enterprise, for the diagram

III.—RAILWAYS.

The curves (Fig. 4, p. 13) show that the commercial soundness of the railway interests in the United Kingdom is in anything but a satisfactory condition.

The mileage of railways open is 22,078.

The capital invested is £1,195,564,478.

The revenue is £106,558,815 ; ratio to capital, 8·9 per cent.

The expenditure is £67,489,739 ; ratio to revenue, 63·3 per cent.

The profits are £39,069,976 ; ratio to capital, 3·27 per cent.

There is no apparent allocation of this difference to depreciation, reserve, or redemption of capital.

While capital is increasing, and the growth of traffic both in passengers and goods is satisfactory, the rate of growth of revenue is stationary, and the difference between expenditure and revenue is seriously diminishing.

The consequence is that dividends are also diminishing.

This state of affairs would be very serious if we did not see daylight ahead.

What are the causes of the present depression?

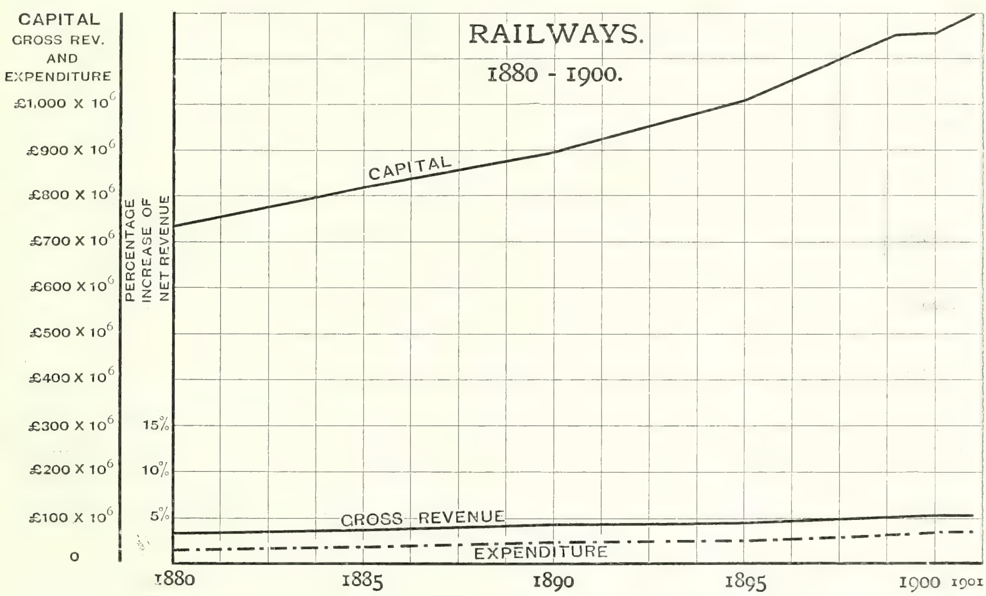
The first cause is unquestionably Parliament, which legislates for the railway world without the least regard to the science of business or the ordinary requirements of commercial prudence. The enforcement of cheap fares and workmen's trains at the expense of the shareholders is pandering to a sentiment, and savours of a bribe to catch votes.

The operation of the Railway and Canal Traffic Acts of 1888 and 1892 forbids our railways being worked on commercial lines so far as goods and mineral traffic are concerned. What is to be said of a law which places an impediment in the way of reducing rates by enacting that they may not be restored, if their reduction be found not to have led to the expected result, without liability to an expensive law suit? Or to the refusal of permission to restore the rate to its old figure without such elaborate proof of change of circumstances as shall satisfy the Railway Commissioners that it is right to do so? Other industries could not live if exposed to such conditions, and their effect is most detrimental to our railways.

The Board of Trade is ceaseless in its application of new regulations. The result of the control of this Department has been most beneficial to the safety of the travelling public. The lives saved annually are untold. We have every reason to be proud of the security of our lines. But the finances of our railway companies have been sadly dislocated by this enforced incessant expenditure, and our managers are much exercised to determine what to charge to capital and what against annual revenue.

The local authorities and municipalities also are insatiable in their unscrupulous assessment for local taxation. The growth of this drain on the resources of the companies is alarming. The taxation of railways has increased 75 per cent. in the last decade, while that of the whole community has increased only 39 per cent.

Fig. 4.



Trade unionism has generated a serious labour trouble. Shorter hours, greater pay, enlarged staff are very desirable for the men themselves, but these advantages are not to be acquired if they lead to financial deadlock and to the disregard of the dictates of commercial law. The men cannot obey two masters, nor can the first masters submit to the external management of their business by self-constituted second masters. If this were submitted to, chaos and bankruptcy would be the result.

The railways are now subject to a very serious competition in the introduction of

electric tramways in their suburban districts. The American railway companies have recognised this, and they have not only electrified their suburban lines but they have developed a tramway system themselves to act as feeder to their own system, and to enable them to close stations and transfer passenger traffic to street tramways.

Automobiles will also certainly interfere with passenger traffic.

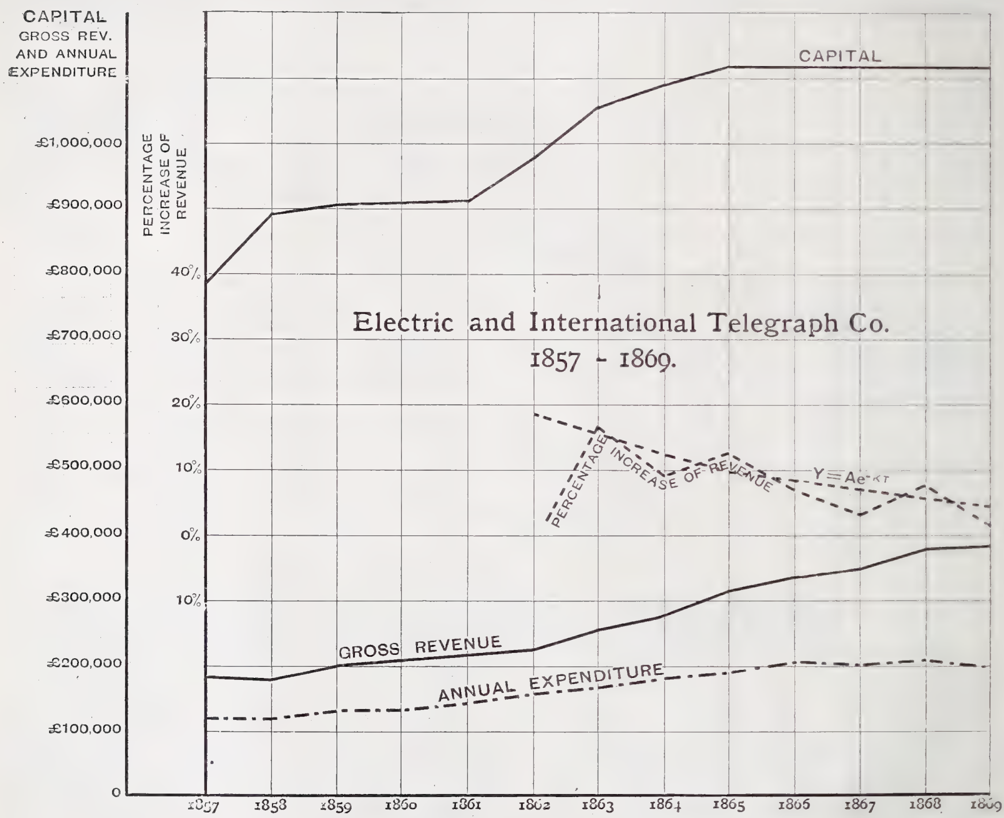
But the most serious element of financial disturbance is competition among the great railway companies themselves. The demand for increased speed and greater comfort has led to new stations, big hotels, larger locomotives, superior coaches of greater capacity, heavier rails, straightened curves, revised gradients, reduced distances. Capital has been increased without the productive increase of traffic or earning power, for the expenditure is caused chiefly by the necessity to hold one's own.

Now, what is the remedy? I am no believer in the conception that electricity is to be the panacea for every evil. There is little sign at present of our being able to work main lines economically by electric traction.

When, however, a line worked by steam is congested, and you can get no more trains through, as it is on our Metropolitan underground lines, and as it is on many suburban lines, then electric traction comes in to increase the speed of running, to enlarge the carrying capacity of the line, and to reduce the working expenses.

The true remedy is co-operation and combination among the great railway companies themselves, and if the railway companies do not realise this fact, and set to work to put their houses in order, they will find that the last and least desirable, but most effective measure will be enforced upon them by public opinion—the financial control of the railways by the State.

FIG. 5.



IV.—TELEGRAPHS.

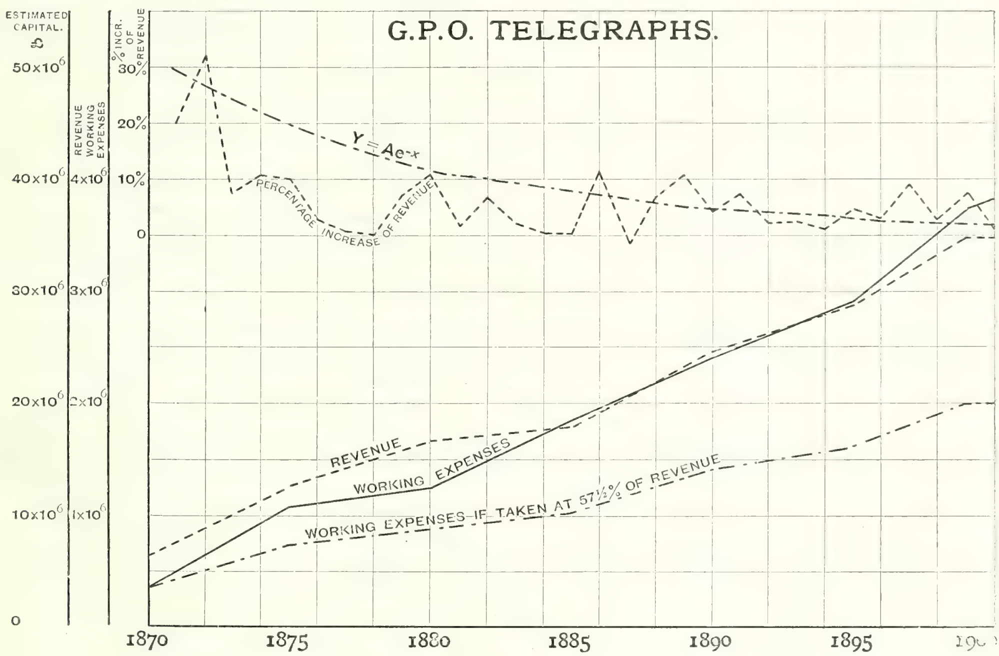
Fig. 5 is a diagram of the business of the Electric and International Telegraph Company

from the year 1857 to its transference to the Government. It shows steady progress and financial prosperity, following the logarithmic curve. The Government made a good bargain in its purchase; it is the fashion to depreciate this purchase. Indeed it is the inalienable right of virtually half the British race to decry the action of the other half. Facts have no effect on party bias. The £5,715,000 paid by the Government for the telegraphs are now worth £30,000,000, and no one believes it!

Fig. 6 shows the growth of this General Post Office business. It also obeys the logarithmic law. There is no capital. Everything is charged to revenue. The working expenses are apparently very high, but if they were taken as they should be, at a fair commercial figure, say $57\frac{1}{2}$ per cent., the profit would be considerable.

(*b*) *Telephones*.—The telephone business of this country defies diagramatic analysis. It has had a curse upon it from its first introduction. It is now in a state of chaotic confusion. It has been the shuttlecock of politicians and the football of local authorities. The attempt to force it on the municipalities is likely to prove a failure. Tunbridge Wells has lamentably broken down. It is an imperial business, a part and parcel of the business of the Post Office, and the only possible solution of the present deadlock is for the Government to cut the Gordian knot and take over the business in 1911.

Fig. 6.



Deductions.

In all well conducted businesses profit is usually distributed to meet:

1. *Depreciation*—which is a term applied to the diminution of the value of the plant as a whole, due to time and work acting upon it, and finally causing its complete decay.

2. *Renewals*—which is a term applied to the periodical replacement with new materials of the parts of the plant that wear out most rapidly.

3. *Reserve*—which is a fund invested *outside the business* formed as a species of insurance to be prepared for emergencies, accidents, and fires, and to meet what we call in England *antiquation* of plant, or what they call in the United States *betterment* of plant.

4. *Redemption*—which is the formation of a sinking fund, in the course of time wiping out the capital raised by loan or subscription.

5. *Dividends* and *bonuses* which are the distribution to shareholders in cash of the surplus of the profit earned.

Sound finance means a proper appreciation

of all these points, and a due and proper allocation of a portion of the annual revenue to meet each requirement. Practice is very variable. Different businesses require different treatment.

In electrical industries depreciation and renewals must be continuous, and must be the first charge against revenue. Electric plant must be maintained in absolute perfect order up to the hilt, otherwise it fails to be productive, and rapidly becomes very inefficient. Hence depreciation and renewals are provided for in the ordinary annual maintenance expenditure. Reserve fund is, however, essential in all growing businesses, and the soundness of the financial control is shown more by the condition of the reserve fund than by any other monetary sign.

Redemption of capital is a compulsory feature of municipal undertakings, erected with capital borrowed under the authority of the Local Government Board. The rate at which the loan is redeemed is determined by the nature of the work undertaken.

The present rule is for—Land, 60 years; Buildings, 30 years; Machinery, 15 years; Electric Mains, 30 years.

No dividends or bonuses are allowed in such municipal industries. The profits are devoted to the amelioration of the rates, but in all businesses established by private enterprise under the Limited Liability Act the surplus profits are distributed as dividends and bonuses. The formation of a good reserve fund is imperative in all undertakings dependent on moving machinery, for invention is so prolific and improvements so rapid that antiquation is soon reached and betterment needed. It is also necessary in the case of private undertakings established under the Tramways or under the Electric Lighting Acts, for in those cases at stated periods the municipality has the power to take possession of the business at its *then* value of the plant, and no allowance is made for goodwill or compulsory purchase. Sound finance seems to show by experience that 2½ per cent. on the capital is about the average amount that should be allowed annually to form a substantial reserve.

There are risky adventures, like submarine cables, where larger amounts should be put aside. The Eastern Telegraph Company is an admirable instance of sound finance. It has been in existence for thirty years. Its invested general reserve fund amounts to £1,164,673 2s. 2d. Its capital is £10,249,170. Its gross revenue is £1,200,000.

The Scrap Heap.

The value of scrapping is not appreciated in England. In America, when a new process is introduced, which effects considerable economy in production, it can be shown by simple calculation that it is wise and commercial to sweep away the old plant and install the new; and this is done. English manufacturers are most tenacious of old machinery. I have seen old Boulton and Watt machinery at work that absorbed annually an excess of coal and oil costing sufficient money to have justified its removal a generation ago. But it is in the increased rate of production that justification for scrapping comes in. The American does not wait until a machine is worn out before condemning it. As soon as he realises the fact that up-to-date machinery will save him in time and labour enough to justify new plant, away goes the old plant, and the value of the new is soon repaid by greater production. In the majority of cases the "betterment" of machinery is charged against revenue, but it is easy to justify its charge against capital if the value of the increased production exceeds the interest on the sum of the capital invested in the old and in the new plant. However, the judicious manufacturer should be fortified with a reserve fund to provide against antiquation and provide for betterment.

Co-operation and Combination.

There seems something radically wrong, from a scientific point of view, in some of these gigantic "combines" that have originated in the U.S.A. It is startling to find that each holder of £1,000 in the White Star Line will receive £14,265 for his share from the new Atlantic Shipping Combine. Upon what capital is profit to be distributed which will enable the new holder of £14,265 to be as happy as the late holder of £1,000? Whence are the new profits to come?

It is not even clear where the money is to come from (or the traffic to pay that money) to gain any profit whatever on the millions projected to permeate the soil of London with "tubes."

On the other hand combinations and co-operative societies, associated with a judicious system of management, must offer considerable economic advantages in encouraging production, maintaining fair prices, securing good markets, and adjusting a margin between expenditure and revenue which will satisfy buyer and seller. The co-operative

system which is such a feature of Scandinavian agriculture has been introduced into Ireland with marvellous financial success. This is due greatly to its non-political and non-sectarian character. The nature of trade organisations and modern home industries is everywhere changing. The individual is merging into the organisation. Self-help is the key of the situation. It is very remarkable that we have been taught this new doctrine of economics in Ireland. There are 630 co-operative societies in that country, with 65,000 members (shareholders), all farmers and heads of families. The annual trade turnover is £1,250,000. The rate of growth of all branches is most satisfactory and encouraging. We, in my native country of Wales, are watching this improvement with great interest, and I hope soon to find that my countrymen have made up their somewhat conservative minds to follow Ireland's good example. Ireland acquired from Wales the light of learning and of religion. Let us hope that she will return the gift by giving Wales the light of co-operative commercial economic prosperity which has been accomplished there by "the familiar magic of common sense."

The key of commercial success is the discovery or construction of a new market aided by a cheap and reliable mode of distribution. The parcel post is the most efficient means at our disposal to distribute the products of home industries throughout the United Kingdom. Every town and every house thus becomes a new market. We have to educate heads of families in these facts. This can be done by societies and local industrial exhibitions. Advertising is now a science.

Commercial Supremacy.

The way in which other nations are assailing our commercial supremacy is well illustrated by the following extract from a technical paper:—

"Messrs. Colbran and Bostwick are Western Americans. They were sub-contractors on the pioneer railway now running successfully under Japanese management between Seoul and Chemulpo, the bridges, permanent way, rolling stock and locomotives of which are all American. . . . . . .

They not only control the electric light and power in Seoul, the capital of Korea, but they hold the concession for long-distance and local telephony for the whole empire, and they have secured the contract for future extensions of the electrical tramway system, the first section of a fairly large system of waterworks for the capital. They are also, with some truth, credited with the establishment of an American-Korean bank, the first attempt to initiate some reform into Korean finance, in which they are assisted by the establishment of a small steam coinage factory, which, it is hoped by the astute promoters, will some day develop strength enough to be a reliable foundation for a Korean Imperial mint and national banking system. It may be argued by those who know Korea that such institutions are at present purely visionary, but there is no knowing when they may become positively practical, and in view of present relations between Great Britain, Japan and Korea, there can be no possible doubt of the important value of the wedge which will open up the country, the thin end of which is now being carefully inserted by our American cousins."

I read in Frazer's "The Real Siberia": "The building of the mighty Trans-Siberian Railway has attracted the attention of traders. Americans and Germans are already in the country opening up commerce. The British, however, lag behind."

The crying demand of our countrymen abroad is for representatives who will make the interests of the British merchant their own. What the merchant wants, to secure him an equal chance for business with the rest of the world, is broad-minded and energetic Consuls, and from the facts I have detailed above, it would seem as if there existed sound cause for recommending a great deal of the American method in the constitution and working of a new commercial Consular service, whose motto should be, "English Trade and Commerce, First, Last, and all the Time."

The Germans have an admirable Intelligence Department all over the world. If any electric development is foreshadowed or suggested in any one of our colonies, especially those in which my firm acts as consulting engineer, we at once receive intimation of the fact from Germany and often from America. We never once have received similar information from any British source!

Commercial Education.

I have endeavoured, to the best of my ability, on every occasion to point out that the retardation in commercial progress in the United Kingdom is not due so much to want of scientific education in the men as in the masters. It is the masters who have allowed the Americans and the Germans to oust them out of their own markets, not by any superiority in the quality of their goods, but by lower prices, by superior knowledge of the de-

mands of the markets, by the establishment of new markets, by better direct communication with foreign countries, by superior methods of business ways, by establishing regular intelligence departments, and, above all, by possessing and exercising superior commercial technical knowledge.

There is a science in business as in manufacture. We want our business men to be technically educated. Their brains must be trained as the Germans have been trained,—to guide their business habits by language, observation, generalization, and common sense. They must lay aside the habits of their fathers. It is very satisfactory to find our new universities establishing commercial faculties.

The University of Birmingham has created a Faculty of Commerce, the first in the United Kingdom, and it began its work on October 1st, 1902. Its object is to educate in the scientific bases of commerce, not the rank and file, bnt the officers of our industrial army. Industries, trade, and manufactures are the dominant interests of the present day. They are managed by all classes of society. The peer rubs noses with some village Hampden over the office desk. It is surprising that the principles and development of commerce have been so long neglected in our schools. A knowledge of the science of business must assist the early experience of the man of business in learning practically the best modes of transacting his business. It is technical education of the highest type. The establishment of a Faculty of Commerce will revolutionise college life. Every seat of learning must copy Birmingham. It will make college life essential for the man of business—the reverse of the popular notions of the past, which regard a college career as unfitting for a future business calling. College training must give an intellectual and lively interest in a student's future calling, whether it be a learned profession, a political life, a military occupation, or a business vocation.

The Society of Arts has long held the position of pioneer in the matter of Commercial Education. It is now nearly fifty years since (in 1853) the Council of the Society first took up the question of examinations, and considered a proposal submitted to them by Mr. Chester for the establishment of a general examination system. It was not, however, until 1856 that the proposal bore fruit, for in that year 52 candidates were examined in London. The subjects of examination included not only Book-keeping, Arithmetic, and Drawing, but also Elementary Science, Geography, History, and Literature. The only two foreign languages were French and German.

In the next year a provincial examination was held at Huddersfield, but it was not until 1858 that the system was inaugurated which has since developed to such an important extent, and simultaneous examinations at a number of different centres under the supervision of local committees were established. As regards the invention of this system, the Society must share the credit with the College of Preceptors. That Institution in 1853 tried the experiment of collecting pupils at local centres, and of examining them by means of papers sent down from London. It was at one time thought that the two systems would clash, but it was soon found that the College and the Society occupied entirely different ground, and the two systems have never interfered in any way with one another.

In 1858, 58 institutions sent up 288 candidates. The numbers increased steadily till 1865, when there were 2,160; and they have grown with an almost continuous increase until last year we examined 15,578.

During the long period over which the examinations have now extended there have been considerable and great alterations. It was at first intended that the examinations should include all the elements of a general education. The establishment of the University Local Examinations in 1858, and of the Science examinations of the Science and Art Department (now the Board of Education), led to the abandonment of many of the original subjects. On two occasions, in 1871 and in 1879, it was considered that the ground was adequately occupied by other institutions; but the decision of the Council to abandon the Society's examinations was on both occasions rescinded in consequence of the urgent representations from the local institutions through whose agency the examinations were carried out. In 1876 the Programme was revised, and a more purely commercial character was given to the examinations. It was also proposed to award, in addition to the certificates always granted for single subjects, a commercial certificate to be given to all candidates who had passed in a certain number of subjects. This proposal was not successful at the time, nor does it appear to be very much more popular at the present date, for though it was renewed two years ago there have not as yet been any applications for such a certificate.

On the other hand, in Cardiff University they have abandoned the granting of certificates for simple subjects and give them only for groups.

Up to 1880 the examinations had been free. In 1881 the examinations were actually dropped, but they were renewed in 1882, and a fee of 2s. 6d. was charged to each candidate. This fee has since been continued, and for the last few years the examinations have been self-supporting, and the Society has thus been relieved of the very heavy drain on its resources which the examinations previously caused.

Up to the year 1901 only one grade of examinations was held, certificates of three classes being awarded, although for many years there existed a system of elementary examination for which the Society supplied identical examinations, the results being examined and the certificates awarded by examiners appointed by the local boards. This system, which was never very successful, was abandoned in 1895. In 1901 the experiment was tried of establishing a second or lower grade, and it has proved extremely successful, for in the first year 4,458 papers were worked, and in the present year there was a slight increase, the number being 4,803.

I may add that this year the Society has successfully introduced a system of *vivâ voce* examinations in foreign languages. It is obvious that these cannot be carried out on the same system as examination by written papers, and therefore arrangements have been made for the Society's examiners to visit the local centres at convenient dates, and examine such candidates as may be entered for the purpose. The first of these examinations was held in May last. Since that date examinations have been held in French, German, and Spanish, at five centres in London and the provinces, to which 280 candidates were sent up, of which 202 passed and 78 failed. It is worthy of note that in the Birmingham University no student will receive the degree of Bachelor of Commerce who does not pass in two modern foreign languages, German, French, Spanish, or Italian.

Our Fiscal System.

The supremacy of the commercial and industrial position of the United Kingdom has practically ceased. Can it be recovered?

I have endeavoured to show that this is greatly due to our want of commercial education and to our obsolete business habits.

There are, however, two other causes that require our most serious consideration. The one is *want of commercial patriotism*; the other is the *Free Trade fallacy*.

No one can have travelled in the United States or met Americans in Europe without being struck by their intense patriotism. They often carry the stars and stripes with them, and decorate even their rooms in French and English hotels with their flag. "America for the Americans," is their motto, and they exclude every other industry but their own by great protective tariffs. They have thus a great home market—virtually a monopoly—behind them, which is a grand guarantee for the capital required to maintain their active competition in other countries.

There is no such motto as "Great Britain for the Britons." Here we are loyal to everybody but a Briton. Our industries not only receive no protection, but they are retarded by internal restrictions of the worst character, and our manufacturers are handicapped in every direction. Railway companies favour foreign productions by giving preferential rates, and freights are excessive. A case came within my own experience where a contract went to America because the freight from one of our Lancashire towns was 25s. per ton, while from Philadelphia it was only 16s. 6d.!

The average man who is not wedded to party politics feels strongly that there is something wrong in the doctrine of Free Trade. Nations which have not adopted it have flourished, more than the solitary nation that has. Our working man does not earn as much money as the American working man, nor does he live so well, nor bear so high a character. The burden of taxation falls on our industries, and reacts on our working classes. We admit, free of duty, those articles which compete with our own industries, and tax those which do not. We remit the tax which would be paid by the foreign producer, while we exact that which falls upon our own subjects. Tariffs in all countries are excluding our commerce. We are being beaten not only in neutral markets, but even in our own. We have spent £300,000,000 in making South Africa an integral part of the British Empire, and at once it is made an open market to our competitors who have paid nothing towards the formation of the market, but have reviled us in ways that will not easily be forgotten.

The great prosperity which followed the introduction of Free Trade was due to the

applications of steam and electricity, to railways, steam shipping, telegraphy, the penny post, the increase in the rate of production. These were shared by other nations. The class which is benefited by our strange fiscal policy is the foreign producer, who, supported by his own strong home market, competes with English manufacturers in their own markets on unfair and unequal terms.

Surely he should be made to pay something to enable us to educate our own people to meet him on fair and equal terms. Our technical institutions are languishing for the want of financial support. I have only to-day taken part in a begging function to solicit support for the very college—King's College—in which I was myself educated. Such an appeal as was made to-day would be instantly responded to by some patriotic millionaire in America. Five per cent. *ad valorem* duty on foreign manufactured goods would place technical and scientific education in this country on a solid basis.

Lord Playfair said in 1891, when speaking of the McKinley Act in the United States: "If the Americans be right in principle, and if they be successful in practice, the whole policy of the United Kingdom is founded on a gigantic error, and must lead to our ruin as a commercial nation." The average Englishman thinks that the error is at home, and that, unless we wake up and "pay the piper," Lord Playfair's fear will be realised.

I scarcely hope to believe that I have in this address established my position that there is a definite science in business, and that I have indicated the laws of this science. I have, however, shown that diagrams, properly maintained and studied, teach absolute facts, and it is the observation of these facts, and the deduction of laws from them, that form a basis of science in manufactures, commerce, business, and even government itself, which, if true and followed, will retrieve our commercial preeminence.

After delivering the Address the Chairman presented the Society's medals which were awarded for papers read during last Session.

For papers at the Ordinary Meetings:—

To J. Gordon Parker, Ph.D., for his paper on "Leather for Bookbinding."

To Herbert Stone, for his paper on "The Identification of Wood, and its Application to Scientific and Commercial Purposes."

To Prof. George Forbes, F.R.S., for his paper on "Range Finders."

To Prof. Roberts Beaumont, M.I.Mech.E., for his paper on "Recent Inventions in Weaving Machinery."

To E. Price-Edwards, for his paper on "Sound Signals."

To J. Clifton Robinson, Assoc.Inst.C.E., M.I.E.E., for his paper on "Electric Traction: London's Tubes, Trams and Trains."

To Major-General Sir John F. Crease, K.C.B., for his paper on "Ceuta and Gibraltar."

To Edward T. Scammell, for his paper on "The Timber Resources of the Australian Commonwealth."

To H. Warington Smyth, for his paper on "Boats and Boat Building in the Malay Peninsula."

In the Indian Section:—

To Professor Wyndham R. Dunstan, F.R.S., for his paper on "The Coal Resources of India."

To Thomas William Holderness, C.S.I., for his paper on "The Indian Famine of 1899, and the Measures Taken to Meet it."

To Thomas Jewell Bennett, for his paper on "The Past and Present Connection of England with the Persian Gulf."

In the Colonial Section:—

To Commander B. Whitehouse, R.N., for his paper "To the Victoria Nyanza by the Uganda Railway."

To W. T. Preston, for his paper on "The French-Canadian Relationship to the Crown."

In the Applied Art Section:—

To Halsey Ricardo, for his paper on "The Architect's Use of Enamelled Tiles."

To Rev. Herbert Thurston, S.J., for his paper on "The History of the Rosary in all Countries."

The Chairman then presented the Society's gold medal, awarded under the Shaw Trust for Industrial Hygiene:—

To Mr. James Tonge, Junr., of Westhoughton, Lancashire, for his Hydraulic Mining Cartridge—an appliance for breaking down coal in mines without the use of explosives.

Sir Owen Roberts, in proposing a cordial vote of thanks to the Chairman for his valuable and most interesting address, said that while he thought there were scientific methods in business, he doubted whether there was an actual science of business. He most thoroughly agreed with what Sir William Preece had said as to the necessity of academical education in England taking cognisance of commerce The New University of Birmingham had begun on the right lines, and the University of London had taken the same course, recognising a faculty of commerce and industry. There were also in London some admirable institutions at which scientific methods in business could be learned. The London School of Economics, lately erected in Clare Market, was an institution which need not fear comparison

with any school of commerce in the world. The City of London College had valuable evening classes in commerce, and a large annex was now being built to the college for the establishment of a day class for the study of scientific methods in business. Those two institutions, coupled with the various classes held in almost all the polytechnics, and the admirable commercial examinations of the Society, left no excuse for the young students of business in London not learning all that could be known of the scientific methods of business. He had not been converted to some of the Chairman's free trade theories. The instance so interestingly quoted of the United States was not, he thought, a case in point. If England was a vast continent with 80,000,000 of people, with all sorts of climate and home industries, it might be a protectionist country too, but such conditions did not obtain.

Sir WALTER PEACE, K.C.M.G., in seconding the motion, said that after 50 years of active trading life he considered free trade, to be the greatest superstition that ever befooled a people. Under the term of free trade—because free trade had never existed and never would—England had throttled the greatest industry of the country—agriculture, and made the people dependent for their food entirely on foreigners. He thought the Chairman in his reference to the prosperity which followed the introduction of free trade had omitted the most important factor of all, the limited liability principle, which, by the aid of the printing press, had increased a hundred fold the actual potential wealth of the country. As an instance of this it would be remembered that American securities depreciated in value 200 millions sterling after the receipt of Senator Blaine's despatch to the Marquis of Salisbury on the Venezuelan question; but the loss was simply on paper, not in cash. He hoped the subject of trade and the fiscal policy of the country would be brought up for discussion at a future meeting of the Society.

The resolution having been carried unanimously,

The CHAIRMAN, in reply, thanked the members for the cordiality with which the resolution had been passed. Sir Owen Roberts had not quite appreciated his term of science as applied to business, thinking that he (the Chairman) should have used the term scientific methods for business. His idea of science was that propounded by Thomas Huxley, who said that science was systematised or organised common-sense. If organised common-sense was not the basis of business, what was? And as organised common-sense was science, science was the basis of business. He had been pleased to hear there were so many commercial schools in existence, and would have mentioned the fact in his address if he had been previously aware of it. The formation of such schools should be urged everywhere, but money must be forthcoming to accomplish the object. He had not advocated protection. His idea of a tax on foreign manufactures was no more protection than the recently imposed tax on corn; the price of bread had not been raised. A five per cent. *ad valorem* duty on those goods which were flooding the markets of the country, would produce $4\frac{1}{2}$ millions per annum of the out pockets of the foreign producer, and on that sum it would be possible to raise 150 millions, which could be devoted to the erection and equipment of technical institutes all over the country. It was not a political matter at all; it was a pure business matter, and Lord Rosebery had stated that the British Government should be run on business principles.

Miscellaneous.

JAPANESE SHIPBUILDING.

For years the policy of Japan has been directed with the view of building up a strong navy and merchant marine. Her position in the East is, in many respects, analogous to Great Britain in the West, and according to the United States Consul-General at Yokohama, her aspirations and opportunities both point to the sea as furnishing her best defence in case of war, and a profitable vocation for her sons in time of peace. With this object the Government is planning regular and systematic additions to the strength of the navy, and is seeking the best means for the encouragement of shipbuilding. High ship subsidies have long been paid, and any plan which promises to promote the establishment of iron manufacturing plant, and other industries necessary to shipbuilding, receives careful consideration. In 1892, about one-thirteenth of the exports, and one-eighth of the imports of Japan, were carried in Japanese vessels; in 1901, its shipping had increased so much that three-eighths of the exports, and one-third of the imports, or a tonnage considerably in excess of the total imports and exports of 1892, were conveyed in native vessels. The tonnage of Japanese merchant steamers entering Japanese ports in 1901 amounted to 3,861,659 tons, and this was surpassed only by the British ships, with a tonnage of 4,080,583 tons. Germany and Russia both exceed the United States, from which country 175 ships, with a tonnage of 404,724 tons, entered Japanese ports. One of the largest steamship companies in Japan is the Nippon Yusen Kaisha (Japan Steam Mail Company), which has lines of boats making regular trips to ports in Europe, America, Australia, British India, China, and Korea. At a recent general meeting of the company it was proposed to assist in the establishment of a new route by the Hunan Company of China, the object

being to secure feeders for the steamers at the Shanghai terminus. While striving to build up their shipping, the Japanese are not unmindful of the necessity for good harbours. Yokohama is the most northerly port in the empire, and Yedo Bay, on which it is situated, forms an ideal natural harbour, much resembling San Francisco Bay in its narrow mouth and wide expanse. A substantial breakwater renders still more secure the upper part of the bay, which is being continually improved by dredging and the extension of dock facilities. A dock is also being built at Hakodate, on Tsugaru Strait, which is between the principal island and the northern one. It is expected that this will be completed within the year, and Hakodate will probably become a naval repair station for Japanese men-of-war and such foreign vessels as may desire to come in. During the past three years, the number of vessels passing through the Tsugaru Strait has more than trebled, some boats which travelled by the Inland Sea, and coaled at Nagasaki or Moji, having latterly preferred to take the northern route and coal at Mororan. Those who favour this route claim that the current here is more favourable, that there is less danger of encountering stormy weather, and that the voyage is shortened.

Correspondence.

BRAZILIAN CARBONS.

I have perused, with much interest, the article in your *Journal* of the 14th November, *re* Brazilian diamonds and carbons. Regarding the largest carbon ever found, it was not broken up in Paris, I broke it up here myself. The exact weight was 3,078 carats. I bought the stone on the 24th September, 1895, for £6,464, broke it up in pieces suitable for use in diamond drills, and resold the whole at ten per cent. profit. Had I the stone now it would be worth £26,163. The present price of carbon at the mines for good carbons one carat and upwards is £8 10s. to £9 per carat, not £5.

J. K. GULLAND.

8, Victoria-street, London, S.W.
17th November, 1902.

General Notes.

A SUBSTITUTE FOR CELLULOID.—The extensive commercial use of celluloid has caused many people to seek for substitutions or imitations of it. In Germany, in the vicinity of Coburg, an imitation has been made by dissolving in 16 parts — by weight—of glacial acetic acid, 1·8 parts of nitro-cellulose, and adding 5 parts of gelatine. Gentle heating and stirring are necessary. After the mass has swollen, it is mixed with 7·5 parts of alcohol, and stirring is continued. The resulting product is poured into moulds, or after further dilution may be spread in thin layers on glass. Consul-General Hughes, of Coburg, is of opinion that "as an underlay for sensitive photographic films, the material has important advantages, not the least being that it remains flat in developing."

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 24...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. Vivian B. Lewis, "The Future of Coal Gas and Allied Illuminants."
East India Association, Westminster Palace Hotel, 4 p.m. Mr. R. H. Elliot, "The Economical Effects of Recent Indian Currency Legislation."
Scottish Society of Arts, 117, George-street, Edinburgh, 8 p.m.
Chemical Industry (London Section), Burlington-house, W., 8 p.m.
Imperial Institute, South Kensington, 8½ p.m.
Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on paper by Mr. C. H. Hooper, "Compensation for Fruit Planting."
Geographical, University of London, Burlington-gardens, W., 8½ p.m.
Actuaries, Staples-inn Hall, Holborn, E.C., 5½ p.m.
Camera Club, Charing-cross-road, W.C., 8½ p.m. Mrs. Le Blond, "Mountaineering from a Woman's Point of View."
Medical, 11, Chandos-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Dr. A. Smith Woodward, "Some Newly Discovered Extinct Animals."

TUESDAY, Nov. 25...Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on paper by Messrs. Charles Hopkinson, Bertram Hopkinson, and Ernest Talbot, "Electric Tramways."
Photographic, 66, Russell-square, W.C., 8 p.m.
Anthropological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, Nov. 26...SOCIETY OF ARTS, John-street, Adelphi. W.C., 8 p.m., Dr. Gustave Goegg. "Le Tunnel du Simplon, et la Nouvelle Ligne de Chemin de Fer Directe Anglo-Italienne pour l'Orient." (In French.)
Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.
British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, Nov. 27...Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 6 p.m. The Hon. J. H. Turner, "British Columbia."
Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Prof. Sir Oliver Lodge, "Electrons."
Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. W. Webster, "History of the English Ballad from the Earlies Times."

FRIDAY, Nov. 28...United Service Institute, Whitehall-yard, 3 p.m. Commander H. Orpen, "The Origin, Evolution, and Future of the Personnel of the British Navy."
Clinical, 20, Hanover-square, W., 8½ p.m.
Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

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FRIDAY, NOVEMBER 28, 1902.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, December 1, 8 p.m. (Cantor Lecture.) Professor Vivian B. Lewes, "The Future of Coal Gas and Allied Illuminants." (Lecture II.)

Wednesday, December 3, 8 p.m. (Ordinary Meeting.) Alfred Watkins, "Some Aspects of Photographic Development."

[A collection of Developers and Developing Apparatus will be exhibited in the Library.]

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, December 31st and January 7th, at 5 o'clock, by Professor Edward B. Poulton, M.A., D.Sc., F.R.S. (Hope Professor of Zoology in the University of Oxford), on the "Means of Defence in the Struggle for Life among Animals."

Lecture I.—"The Methods by which Animals hide in order to escape their Enemies and catch their Prey."

Lecture II.—"The Ways in which Animals warn their Enemies and signal to their Friends."

Members who desire tickets for the course are requested to apply for them at once.

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

CANTOR LECTURES.

On Monday evening, 24th inst., Professor Vivian B. Lewes delivered the first lecture of his course on "The Future of Coal Gas and Allied Illuminants."

The lectures will be printed in the *Journal* during the Christmas recess.

Proceedings of the Society.

SECOND ORDINARY MEETING.

Wednesday, November 26, 1902; Sir William Henry Preece, K.C.B., F.R.S., Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Aitken, Thomas, Esq., Assoc.M.Inst.C.E., Surveyor's Office, County-buildings, Cupar, Fife, Scotland.
Baker, George Samuel, "Frontenac," Donnington-, road, Willesden, N.W.
Barber, René R., Messrs. William Barber and Bros. Georgetown, Ontario, Canada.
Cole, Charles Henry, Assoc.M.Inst.C.E., H.M. Dockyard, Malta.
Connett, Albert Newmann, M.Am.Soc.C.E., Tyndale-lodge, Bromley, Kent.
Eborall, Alfred Cecil, M.I.E.E., 115, Tulse-hill, S.W.
Foot, Herbert, B.A., F.I.A., 13, Marlborough-place, St. John's-wood, N.W.
Hardcastle, Edward, Rose cottage, New-road side, Horsforth, near Leeds.
Hardy, William Eversley, St. Oswald, Alexandra-road, Norwood.
Northcott, James, 12, Herne-hill, S.E.
Pearson, Captain James Bruce, care of Managing Agents, British India Steam Navigation Co., Ltd., Calcutta.
Simpson, Percy, "Ocean Wave," St. Ives, Cornwall.

The paper read was—

LE TUNNEL DU SIMPLON, ET LA NOUVELLE LIGNE DE CHEMIN DE FER DIRECTE ANGLO-ITALIENNE POUR L'ORIENT.

Par le Dr. Gustave Goegg,

Docteur-ès-Sciences, Professeur à l'Ecole Supérieure de Commerce de Genève.

J'éprouve un vif regret de ne pouvoir m'exprimer assez correctement dans votre langue, pourtant si fertile et si simple à la fois. Heureux j'aurais été de rendre ainsi un

hommage mérité à un pays auquel tous mes compatriotes, comme moi-même, vouent un sincère et profond respect.

L'Angleterre et Genève ont eu depuis des siècles des points de contact nombreux dans presque tous les domaines, aussi bien dans le domaine religieux que dans celui des sciences, des arts, et de la philosophie.

Il y a deux mois à peine, Genève applaudissait avec enthousiasme Sir W. Ramsay votre grand chimiste. Avec son autorité pleine de simplicité imposant le respect et la sympathie, votre savant à l'esprit si distingué, a conduit ses auditeurs dans le for intérieur de ses méditations, émervéillés qu'ils étaient de suivre ce chercheur infatigable au travers des mille difficultés que ses recherches devaient rencontrer. Genève conserve du reste une dette de reconnaissance envers plusieurs de vos grands génies, car poétisée par eux, elle a été ainsi appelée à être une source d'attraction pour vos compatriotes.

George Eliot en effet a dit :

"I am in an atmosphere of love and refinement, I am quite satisfied to be at Geneva instead of Paris; in fact, I am becoming passionately attached to the mountains, the lake, the streets, my room, and above all, the dear people with whom I live."

John Ruskin écrivait en 1886 :

"I am more thankful every year of added life, that I was born in London, near enough to Geneva for me to reach it easily. The Genevese are pure, learned to a man, to a woman, to a boy, to a girl, progressing to and fro, mostly on their feet, and only where they have business. And this bird's nest of a place to be the centre of religious and social thought and physical beauty to all living Europe, that is to thinking and designing Europe, France, Germany, and Italy!"

Lord Byron longtemps notre hôte dans sa résidence à Cologny près Genève a glorifié notre lac Léman :

"Clear, placid Leman! thy contrasted lake
With the wide world I dwell in is a thing
Which warns me with its stillness, to forsake
Earth's troubled waters for a purer spring.
This quiet sail is as a noiseless wing
To waft me from distraction. Once I lived
Torn ocean's roar: but thy soft murmuring
Sounds sweet as if a sister's voice reproved
— That I with stern delights should ever have been so moved."

C'est ainsi que le peuple anglais, guidé par ses écrivains, et amateur de voyages, a été attiré par les ressources que lui offre la nature de notre pays.

Des relations souvent étroites se sont cimentées de familles à familles, nos écoles furent fréquentées par votre jeunesse et peu à peu une large sympathie entre Genève et l'Angleterre en furent la conséquence.

Le trait d'union se confirme encore ce soir, aussi tout naturellement suis-je porté a remercier le Comité de la Société des Arts de l'aimable accueil qu'il a bien voulu réserver à une importante question économique qui préoccupe en ce moment le continent européen et dont Genève est le berceau.

I.—Le Simplon.

Dans trois années au plus tard, la grande barrière des Alpes sera percée d'une brèche nouvelle. Après le Mont Cenis, après le Brenner, après le St. Gothard, le Simplon lui aussi viendra bouleverser le système économique du continent, et apportera dans le commerce des nations sa part d'inconnues auxquelles il faudra se plier.

Le passage du Simplon, historiquement moins célèbre que celui du Grand St. Bernard, est pourtant depuis des siècles déjà considéré comme de la plus haute importance. Il mène exactement de la Vallée du Rhône, d'où il se détache à Brigue, au Val d'Ossola et au Lac Majeur.

Jadis, c'était un chemin de mulets côtoyant d'effroyables précipices à travers les gorges du Gondo pour gagner ensuite les plaines luxurieuses de la Lombardie. De gigantesques combats s'y livrèrent à la fin du 18e siècle entre les troupes françaises et autrichiennes; aussi Bonaparte, désireux d'avoir une belle route accessible à l'artillerie, qui menât en Italie, ordonna-t-il de construire la route actuelle. Elle fut terminée en cinq ans, coûta dix huit millions de francs et peut encore être classée de nos jours parmi les voies les plus belles qui soient au monde. C'est un ingénieur de Genève, M. Céard, qui conçut l'exécution technique de cette route.

Depuis sa création, des grandes malles-postes y ont circulé deux fois par jour, dans chaque sens entre Brigue et Domo d'Ossola. Cette route devint si fréquentée en toutes saisons, le besoin de communications entre la Lombardie et la Vallée du Rhône s'affirmait à tel point, qu'il parut à des esprits clairvoyants qu'une nouvelle percée des Alpes devait se faire sur ce point. Par surcroît l'ouverture du canal maritime de Suez avait tellement modifié les conditions de transit entre l'Europe et l'extrême Orient, que chaque nation du continent européen sentait du plus haut intérêt, d'attirer sur son territoire, la plus grande part du mouvement commercial qui devait en résulter.

La Prusse provoqua le passage des Alpes au St. Gothard, s'unissant à la Suisse, à l'Italie, au Wurtemberg, à Bade, et à la Bavière pour la création d'une voie ferrée destinée à relier les territoires allemands avec Trieste et Brindisi, ports appelés à devenir les points obligés entre l'Europe et l'Orient.

Devant la menace d'un pareil projet, un grand nombre de députés du corps législatif français parmi lesquels citons Gambetta, Sadi-Carnot, Henri Brisson, Edgar Quinet, le Général Billot, etc., déposèrent le 21 Juin, 1870, une proposition de loi tendant à accorder au Gouvernement un crédit de 40 millions de francs pour la percée du Simplon.

Cette proposition disait entre autres :

"Le Gouvernement français doit-il renoncer aux avantages que promet la communication directe des ports de la Manche à ceux de l'Adriatique ? Peut-il hésiter à suivre l'exemple qui lui est donné et ne pas engager résolument la lutte sur le terrain pacifique et fécond où elle est portée et ne pas conserver à la France sa part légitime dans cet immense courant économique ?

"Pour sauvegarder ces intérêts il suffit de relier les lignes italiennes et les lignes françaises par le percement du Simplon, et d'ouvrir au commerce du monde, la ligne la plus courte et la plus directe, entre le Sud de l'Italie et Londres, comme point extrême."

La triste période des douloureux événements survenus en France en 1870 ne permit pas la discussion de cette proposition. La guerre terminée, en 1873 les mêmes patriotes reprirent cette proposition devant le Parlement français : ils disaient : "les intérêts français les plus élevés seraient gravement atteints si le caractère de la ligne internationale du Simplon était modifié. Ce n'est pas d'ailleurs seulement la France, mais l'Italie, la Suisse et plusieurs nations de l'Europe qui sont intéressées au prompt achèvement de cette voie ferrée traversant la chaîne des Alpes au niveau de la plaine du Rhône. Un manque de prévoyance économique a fait sombrer cette proposition devant les Chambres françaises. Le percement du Simplon, sans aucune participation de la France, a été décidé depuis lors, entre la Suisse et l'Italie.

II.—Le Tunnel de Simplon.

Toute la période de 1893 à 1896 fut consacrée aux pourparlers entre ces deux pays, tant au point de vue technique qu'au point de vue financier. Une somme de 70 millions de francs fut jugée nécessaire pour le percement du tunnel seul, et le 13 Août 1898 la Compagnie Jura-Simplon concessionnaire de la ligne, mit officiellement à la disposition de l'*Entreprise* les terrains nécessaires et l'autorisa à commencer les travaux. Aux termes de la convention il résultait :—

1°.—Que les travaux devaient commencer au plus tard le 13 Novembre, 1898 ;

2°.—Que le premier tunnel et la galerie du second tunnel devraient être terminés et livrés, prêts pour l'exploitation, cinq ans et demi après la date fixée pour le commencement de la perforation mécanique, soit le 15 Mai, 1904.

Rappelons que la *Société d'Entreprise du Tunnel du Simplon* se compose des maisons A. Brandt et Brandau de Hambourg, Sulzer frères de Winterthour, Locher et Cie de Zurich, et de la banque de Winterthour.

L'Ingénieur Alfred Brandt très connu par ses grands travaux de l'Arlberg, dirigea dès l'origine jusqu' à sa mort, survenue à Brigue le 25 Novembre, 1899, les travaux de la tête nord.

Son associé, M. Brandau, qui a travaillé au percement d'un grand nombre de tunnels, au Caucase entre autres, dirige les travaux du côté italien.

La maison Sulzer frères de Winterthour renommée dans le monde entier pour ses machines, fournit à l'entreprise ses perforatrices, pompes, etc.

M. Locher qui avait assumé la direction de tous les travaux extérieurs, bâtiments, correction du Rhône, installation des forces motrices, etc., succéda à M. Brandt.

J'ajoute que l'entreprise aurait droit d'après les conventions à une prime de 5,000 francs par jour d'avance, si les travaux étaient terminés avant le délai fixé de 5 ans ½ et il pourrait lui être infligé une pénalité égale pour chaque jour de retard à l'exception des cas suivants : guerre dans laquelle la Suisse ou l'Italie serait engagée, épidémies, grèves générales, tremblements de terre, etc.

L'Entreprise restera pendant trois ans après la fin des travaux du premier tunnel et deux ans après celle du second, responsable de leur bonne exécution. Le cautionnement des entrepreneurs a été fixé à cinq millions de francs.

La longueur du tunnel du Simplon est de 19,770 mètres. Les deux galeries parallèles sont distantes de 17 mètres d'axe en axe. L'altitude maximale est de $704^{m}10$.

Les travaux sont dirigés avec une telle précision que l'on croit qu'il n'y aura guère qu'un écart probable de 6 centimètres à la rencontre des deux attaques au centre du tunnel. Les vérifications d'axe se font 3 à 4

fois l'an, cette opération dure de 24 à 40 heures, nécessitant une interruption complète des travaux.

La Confédération Suisse destinée à être une fois propriétaire du tunnel, compte utiliser sur le côté nord les forces motrices de l'Entreprise, pour la ventilation et l'éclairage du tunnel et éventuellement pour la traction électrique dans l'intérieur de celui-ci. Cette force est prise au Rhône en amont de Brigue et il y a été exigé pour amener l'eau, une canalisation en béton de ciment armée système Hennebique, due à l'ingéniosité d'un technicien Suisse très habile, M. S. de Mollins. Ce canal, long de trois kilomètres traverse des prairies, des éboulis et des pentes abruptes, s'accrochant aussi sur une longueur de 300 mètres à des rochers à pic. Au début la perforation à la main avait donné en moyenne un avancement de 1 mètre 94 par jour, puis les perforatrices une fois mises en activité, l'avancement fut de 7, 8 mètres à 10 mètres par jour. C'est la perforatrice hydraulique à rotation système Brandt qui est employée. Au Gothard la compression de l'air avait été utilisée, mais avait donné un mauvais rendement. Chaque perforatrice travaille sous une pression de 70 à 90 atmosphères; elle a l'avantage d'être utilisable dans une roche quelconque, de la plus dure à la plus tendre, sans donner aucune poussière. Le foret est en acier très dur de 70 à 100 mm. de diamètre, creux, portant des dents tranchantes. Celles-ci sont au nombre de trois ou quatre taillés à la fraise, puis ensuite trempées. Deux, trois, ou quatre perforatrices sont fixées sur un même affût. Avec trois perforatrices, le forage de six à huit trous, prend en moyenne de 2½ h. à 3 heures pour les roches ½ dures, de 4 à 5 h. dans des terrains très résistants. Les trous ont de 1 mètre 60 à 2 m. de longueur. La dynamite dont on les charge est de consistance gélatineuse; on emploie, par attaque, une quarantaine de kilos de cette substance et cela par cartouches de 500 grammes chacune. L'explosion est produite au moyen de capsules et de mèches brûlant à 1 c.m. à la seconde. Les ouvriers se retirent à une distance de 50 à 250 mètres. Cinq minutes après l'explosion deux ouvriers sont chargés d'ouvrir la vanne de la conduite d'eau sous pression à l'extrémité de laquelle est une pomme d'arrosoir: l'eau projetée a pour but de rafraîchir le front d'attaque et les débris, dont la température est élevée, et de condenser les gaz produits par la dynamite. Une puissante ventilation évite que les ouvriers soient trop souvent intoxiqués par ces gas et par la température interne du tunnel. La quantité d'air introduite par 24 heures s'élève actuellement à 2,300,000 m^3 à chaque extrémité. La température intérieure du tunnel a beaucoup varié, elle a atteint un maximum de 50° Centigrade.

L'avancement des travaux accuse jusqu'à fin Octobre dernier 13,608 mètres.

Pendant plusieurs mois les entrepreneurs ont eu beaucoup d'inquiétudes relatives à la marche des travaux, des chutes d'eau considérables se montant à un débit de 1,200 litres par seconde ont même interrompu momentanément les travaux jusqu'à ce que l on ait réussi à capter ce fleuve naissant. Tout semble cependant, ne pas aller à souhait, témoin cette dépêche parvenue de Brigue le 1er Novembre courant annonçant que l'entreprise du percement du Simplon demande que le délai pour l'achèvement du tunnel soit prolongé à l'amiable de quatorze mois, vu les difficultés imprévues qui ont été rencontres, et cela jusqu'au 1er Juillet, 1905.

III.—Les Lignes Françaises d'Acces au Simplon.—Le Percement du Jura.

L'Angleterre, dont la puissance commerciale est la plus imposante, existant à la surface du globe, ne peut assister impassible à toutes les questions économiques qui surgissent sur le continent européen. Elle, vers qui convergent tous les efforts tentés en Europe pour abréger les distances, ne peut pas rester indifférente aux grands projêts qui se préparent.

L'accroissement de sa population, les besoins grandissants d'une consommation et d'un commerce toujours en progrès, lui font un devoir impérieux de les examiner attentivement.

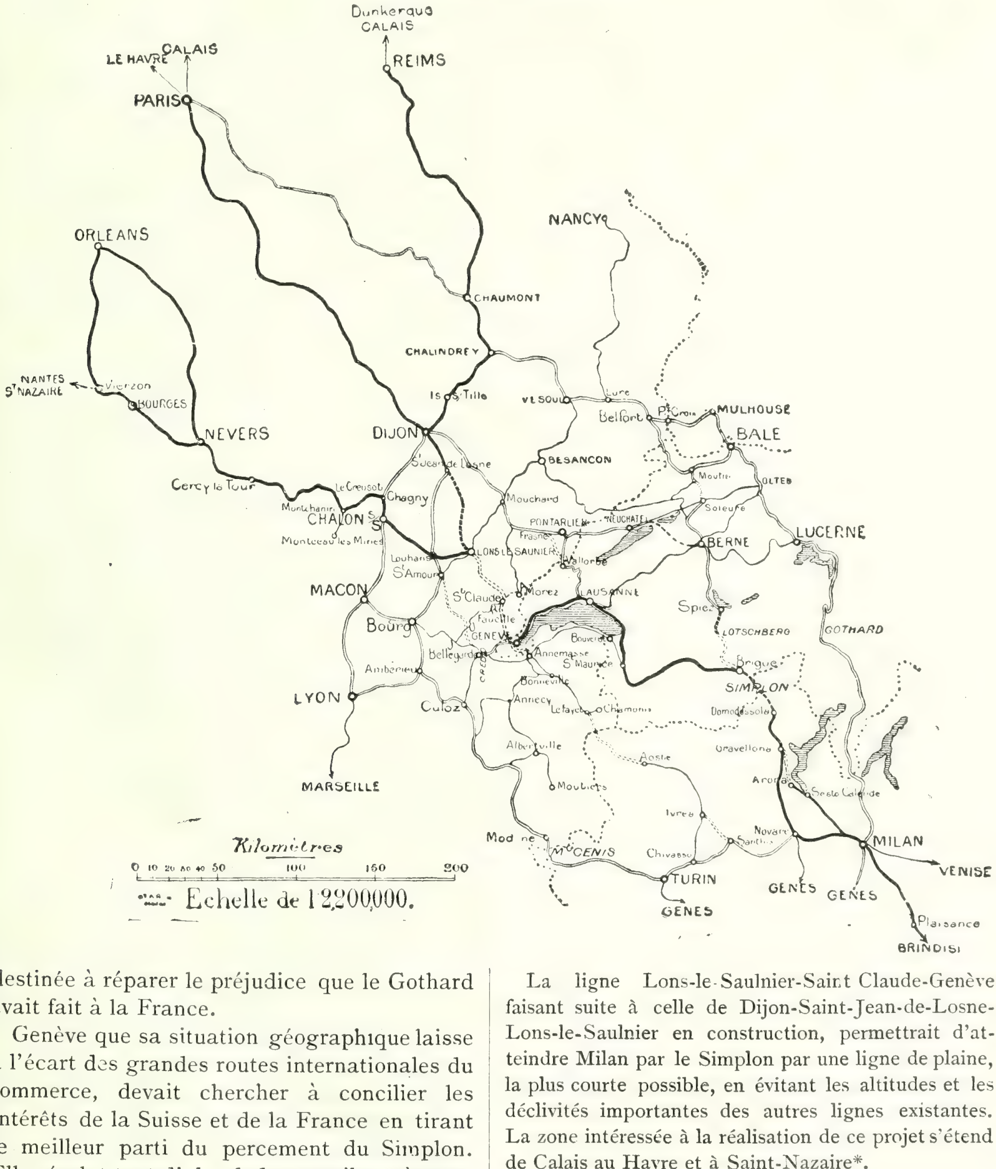
La France croyait en 1873 que le Tunnel du Simplon ne se percerait pas, vu son renoncement à prêter son concours à cette entreprise; elle a eu depuis un triste réveil. Le Gothard qu'elle redoutait, a eu sur ses intérêts la main plus lourde qu'elle ne le pensait. Depuis l'ouverture de cette ligne, de la Manche et de l'Atlantique jusqu'aux plaines de la Russie centrale, de la Méditerrannée à la Baltique, le mouvement des transports se dirige vers cette grande voie ferrée.

Les attractions commerciales nouvelles ont rompu l'équilibre séculaire auquel la France s'était accoutumée. Bloquée dans ses frontières, elle s'est vue repoussée par la concurrence allemande des marchés de l'Italie. Une grande partie du transit anglais et belge a déserté son territoire au grand détriment de

ses ports de commerce et de son réseau ferré. Mais elle semble aujourd'hui avoir trouvé un remède au mal qui la préoccupe.

Un patriote français distingué, Le Président de la Chambre de Commerce française de Genève, M. Bénassy-Philippe, fort soucieux de cet état de choses, prit l'initiative de provoquer une étude susceptible de doter son pays d'une bonne ligne d'accès française au Simplon, dèvoués et décidés à prêter leur concours à M. Bénassy-Philippe. Ce fut l'éminent Ingenieur Th. Turrettini qui en accepta la présidence. Après plusieurs années d'études le comité reussit à élaborer un tracé, reliant Lons-le-Saulnier-Saint-Claude et Genève par une ligne de chemin de fer de 75 kilomètres traversant le massif du Jura dans la région dite de la "Faucille."

Carte Paris-Milan.



destinée à réparer le préjudice que le Gothard avait fait à la France.

Genève que sa situation géographique laisse à l'écart des grandes routes internationales du commerce, devait chercher à concilier les intérêts de la Suisse et de la France en tirant le meilleur parti du percement du Simplon. Elle résolut tout d'abord de contribuer à cette œuvre par une subvention financière importante. Elle eut ensuite la bonne fortune de voir se créer un comité constitué par des citoyens

La ligne Lons-le-Saulnier-Saint Claude-Genève faisant suite à celle de Dijon-Saint-Jean-de-Losne-Lons-le-Saulnier en construction, permettrait d'atteindre Milan par le Simplon par une ligne de plaine, la plus courte possible, en évitant les altitudes et les déclivités importantes des autres lignes existantes. La zone intéressée à la réalisation de ce projet s'étend de Calais au Havre et à Saint-Nazaire*.

* D'après la brochure de M. Ch. Loiseau, *Le Simplon et les Intérêts du Centre de la France* (1902), la zone d'influence s'étendrait de Dunkerque à Rochefort-sur-Mer.

Paris-Milan	949 kilomètres par le Mont Cenis. 893 ,, par le Gothard. 870 ,, par le projet de l'Association.

Cette artère qui serait le prolongement de la ligne présentement en construction de Saint-Jean-de-Losne à Lons-le-Saulnier, abrégerait la ligne actuelle de Dijon-Genève par Saint-Amour, Ambérieu et Bellegarde de 114 kilomètres, et deviendrait la vraie ligne internationale anglo-franco-italienne destinée à conserver à la France, en outre de la "Malle des Indes," convoitée par des projets rivaux en pays germaniques, tout le transit anglo-italien de voyageurs et de marchandises.

Les deux autres projets simultanément à l'étude avec celui de Lons-le-Saulnier-Saint-Claude-Geneve en vue de raccourcir le trajet entre le France et le Simplon, sont :

a).—Rectification de la ligne de Pontarlier par l'exécution d'une ligne reliant directement Frasnes à Vallorbes en évitant Pontarlier. Le raccourci serait de 17 kilomètres sur la distance actuelle de Paris à Lausanne.

b).—Exécution d'une ligne directe de Saint-Amour à Bellegarde raccourcissant de 68 kilomètres le parcours actuel de Paris à Genève par Saint-Amour-Bourg-Ambérieu-Culoz, et rectification de la ligne actuelle de Bellegarde à Saint-Gingolph pour la rendre accessible à un trafic important.

De Calais a Milan.

Par le Mont-Cenis	1,242 kil.
Par le Gothard.....................	1,151 ,,
Par le Simplon Frasnes-Vallorbes ..	1,145 ,,
Par le Simplon Lons-le-Saulnier-Genève, la Faucille	1,168 ,,

Seulement en ce qui concerne le projet (*a*), M. Noblemaire, directeur de la Compagnie P.— L.— M.—, sur la haute autorité duquel nous nous appuyons, reconnaît que l'itinéraire par la Faucille serait, sinon le plus court, du moins le plus rapide entre le nord de la France et l'Italie, les trains de voyageurs devant, en raison du profil beaucoup plus favorable, mettre une heure de moins à parcourir les 870 kilom. de Paris à Milan via Lons-le-Saulnier-Genève, que les 847 kilom. via Mouchard-Pontarlier. Quant au projet (*b*) il semble abandonné, même par ses auteurs.

Il reste donc en présence uniquement le projet Frasnes-Vallorbes et le projet Lons-le-Saulnier-Genève.

Le tableau des profils comparatifs des lignes de Paris à Milan par le Simplon donne une idée de la difference d'altitude entre les divers projets proposés ou lignes existantes.

Cette altitude joue dans la question un rôle autrement important que les distances mesurées sur la carte. Elle est de 559 mètres dans le projet dit "de la Faucille" et de 896 mètres pour celui du Frasnes-Vallorbes.

Les déclivités de Dijon à Genève ne dépassent pas 10 0/00, tandis que celles du Frasnes atteindront toujours du 20 à 25 0/00. On ne marche pas contre la pesanteur, donc les frais d'exploitation d'un chemin de fer à fortes rampes sont directement proportionnels à l'altitude gravie, et cela indépendamment des rampes adoptées pour atteindre cette altitude. La ligne de Lons-le-Saunier-Genève donne de ce fait au Tunnel du Simplon sa pleine valeur.

Le rapport de la Commission d'Etudes extraparlementaire des Lignes d'accès au tunnel du Simplon, nommée par le Ministre des Travaux Publics de France le 15 Juin, 1901, a reconnu les avantages d'une ligne d'accès à faibles déclivités en disant :—

"Une ligne à faibles déclivités de Calais et de Paris à Milan aurait une supériorité écrasante sur tout les lignes concurrentes et en particulier sur celle qui pourrait être établie par le Loetschberg ; elle empêcherait le détournement de la Malle des Indes par Vienne et Salonique. Enfin, l'adoption d'une ligne à faibles déclivités permet de faire passer la ligne du Simplon par Genève et de concilier ainsi les intérêts de cette grande ville avec ceux de la France."

"Dans l'exposé présenté par M. Noblemaire, Directeur de la Cie. P.L.M., à la Commission précitée, il faut citer aussi les passages constatant les conditions favorables à ce projet :

"Il offre, de Paris sur Genève, un raccouroi énorme 20 % (488 kil. contre 605) en distance réelle, et 33 % (526 kil. contre 788) en distance virtuelle ; il mettrait en relations directes avec Genève tout le Jura qui ne l'atteint aujourd'hu qu'au prix d'un long détour ;

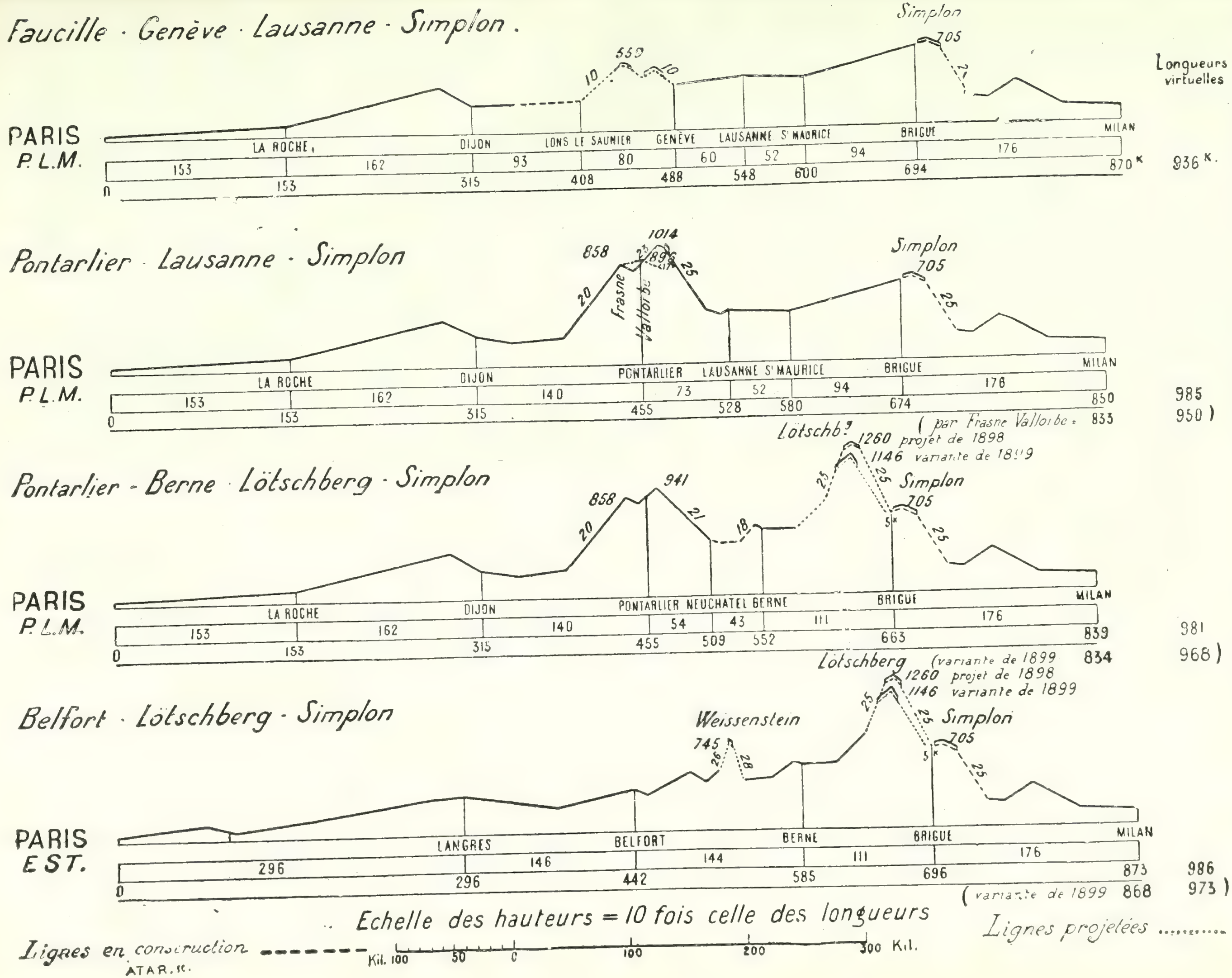
"De Paris à Milan, il constituerait l'itinéraire de beaucoup le plus court en distance virtuelle, c'est-à-dire le plus rapide pour les voyageurs, le plus èconomique pour l'acheminement des marchandises ;

"Il assurerait enfin à la voie de Genève le trafic des voyageurs qui, pour se rendre de Paris à Lausanne ou vice versa, passent aujourd'hui par Pontarlier.

"La ligne de Lons-le-Saunier-Genève serait bien supérieure à ces deux lignes (celles de St-Amour-St-Gingolph et Pontarlier-Lausanne), car alle abrégerait la durée du parcours des trains de voyageurs :

"De 3 heures entre Paris et Genève (488 kil.) par rapport au tracé actuel par St-Amour-Bourg et Culoz (605 kil.) (en longueurs virtuelles 526 kil. et 788) ;

"De plus, de 2 heures entre Paris et Milan par rapport au tracé actuel Bâle et le Gothard. Le même



Profils Comparatifs des Lignes de Paris a Milan par le Simplon.

M. Noblemaire, Directeur de la Compagnie P.-L. M., dans son Rapport du 15 janvier 1901, après avoir fait étudier le projet de l'*Association pour le percement de la Faucille*, le déclare infiniment supérieur aux autres tracés à cause de son profil, et par suite plus économique pour les marchandises, et plus rapide pour les voyageurs.

Cette igne passe à l'altitude de 1.014 m. et présente sur les deux versants du Jura des déclivités de 20 et de 25 °/₀₀, que la correction projetée de Frasne à Vallorbe n'élimineraient que sur une faible partie du parcours. On ne pourrait améliorer son profil que par des allongements onéreux.

La ligne projetée pour atteindre le Simplon par le Lœtschberg participe des imperfections de la ligne passant pa Pontarlier sur le versant français, et doit s'élever pour la traversée des Alpes bernoises jusqu'à 1.260 m. ou 1.146 m. d'après le dernier projet plus court de 5 kil., mais nécessitant un tunnel de plus de 18 kil.

Le projet de percement du Weissenstein permettrait aux lignes de l'Est français d'atteindre directement le Simplon en passant par le Lœtschberg. Ce tracé aggrave les conditions d'exploitation déjà défavorables du Lœtschberg en nécessitant des déclivités trop fortes entre Mout'er et Soleure.

raccourci existerait dans le trajet Paris et Brindisi suivi par la Malle des Indes et convoitée par l'Autriche pour Salonique."

Un projet aussi grandiose s'imposa peu à peu à l'attention des économistes et des hommes d'affaires. Le Comité de Genève a eu la grande satisfaction de voir se créer d'autres Comités, dont un très actif à Paris sous la Présidence du Sénateur M. Ch. Prevet. Puis de constater que les Chambres de Commerce des diverses régions de la France n'ont pas tardé à appuyer la création de cette ligne. Jamais sur le territoire de la France un tel élan pour une étude économique ne s'était manifesté. Un écrivain des plus distingués, M. Charles Loiseau, a fait tout dernièrement à propos d'une enquête ouverte par le Ministère français du Commerce un classement très suggestif, en groupant par régions, les intérêts variés auxquels répond le percement du Jura. Il est arrivé au résultat suivant.

1°.—*Groupe Des Ports De La Manche.*—Les Chambres de Commerce de tous les grands ports de la Manche ont donné la préférence au projet de la Faucille—soit celles de: Boulogne-sur-Mer; Calais; Cherbourg; Dieppe; Dunkerque; Honfleur; Rouen.

La plupart de ces Chambres de Commerce, organes des ports qui font tête à l'Angleterre, se préoccupent naturellement de la concurrence à organiser contre la ligne du Gothard et du passage de la Malles des Indes par le territoire français. Celle de Dunkerque par exemple, s'exprime en ces termes:—

"Le percement du St. Gothard a eu pour résultat immédiat de faire passer par cette voie et sur les lignes étrangères, Suisse, Allemagne, Belgique, presque toutes les marchandises d'un prix élevé, telles que la soie, les fruits frais ou secs, les légumes, le lait condensé, le fromage, etc., etc., expédiés d'Italie en Angleterre.

"Précédemment ces marchandises prenaient la voie du Mont-Cenis et traversaient toute la France de Modane à Boulogne, Calais ou Dunkerque.

"Ce détournement de trafic a donc frappé non seulement nos chemins de fer, mais nos ports et les lignes régulières de navigation qui les desservent.

"Le tonnage ainsi détourné est d'une importance telle, qu'il a contribué à la création d'une ligne régulière quotidienne entre Ostende et Tilbury-Dock [Londres].

"Pour donner une idée de l'importance de ce tonnage, il suffit de citer les transports de fruits et légumes expédiés par Dunkerque via Hull et Goole.

"Ce tonnage, pour la dernière campagne, de Juillet à Octobre 1901, s'est élevé à plus de 300,000 kilogrammes et ne présente qu'une fraction très faible du tonnage des fruits et légumes expédiés sur l'Angleterre.

"Le percement du Simplon procurera une voie plus courte et d'une exploitation moins coûteuse et pourra avoir pour résultat de ramener sur les lignes françaises et dans nos ports—Boulogne, Calais, et Dunkerque à une partie très importante du trafic perdu par suite du percement du St. Gothard.

"Et, après avoir comparé les divers projets, la Chambre de Dunkerque n'hésite pas à conclure:

"Dans ces conditions, nous ne pouvons que proposer de donner un avis très favorable à la construction de la ligne de la "Faucille" reliant Lons-le-Saunier à Genève par St. Claude."

M. le Président Darquer, à la réunion de la Chambre de Commerce de Calais, le 25 Avril dernier, s'exprimait également ainsi:

"Le port de Calais étant la tête de ligne des relations entre la Grande-Bretagne, la Suisse et l'Italie, a un intérêt considérable à voir les communications entre ces points s'établir d'une façon plus rapide et plus économique. Aussi nous empressons-nous de répondre à l'appel de la Chambre de Commerce française de Genève en lui faisant part du vœu que nous exprimons ici:

"Qu'il faut à tout prix contrebalancer la fâcheuse influence qui se fera sentir sur le trafic général francais à l'ouverture de la ligne nouvelle du Simplon;

"Qu'il faut arrêter la décadence que nous avons subie déjà par la concurrence que nous fait la ligne du Saint-Gothard;

"Qu'il faut donc choisir vite entre les projets à l'étude celui qui peut le plus facilement aboutir."

"Par notre situation nous avons à nous occuper, avant tout, du trafic des voyageurs et incidemment du service postal de la malle des Indes. Nous dirons donc avec M. Noblemaire, directeur de la Compagnie P.-L.-M.;

"Que les voyageurs réclament la durée minima du trajet, etc."

2°.—*Groupe Des Villes Industrielles du Nord.*—Les Chambres de Commerce de la plupart des grandes villes industrielles du Nord ont adhéré au projet de la Faucille—soit celles de:—Amiens, Beauvais, Cambrai, Douai, Lille, St. Omer, St. Quentin, Roubaix, Tourcoing, Valenciennes.

Les raisons qui paraissent avoir inspiré ces compagnies se tirent d'abord de l'intérêt général, envisagé comme l'on fait les organes des villes maritimes du Nord. Les Chambres de Commerce de Beauvais et de St. Omer notamment, ont élaboré à ce sujet, des délibérations aussi complètes que concluantes. D'autres en établissant les statistiques du commerce de la région du Nord avec la Suisse et l'Italie, démontrent, par le fait même, l'intérêt de cette région à être reliée aux

marchés suisse et italien par la ligne la plus rapide et susceptible de l'exploitation la plus aisée. Celle de Lille est très affirmative sur ce point.

3°.—*Groupe Des Ports de L'Atlantique.*—Ont adhéré au projet de la Faucille les Chambres de Commerce de:—Bordeaux, Brest, La Rochelle, Nantes, St. Nazaire, Rochefort.

Les compagnies qui représentent les intérêts de ces ports se sont inspirées de l'utilité d'un système de communication, soit ferré, soit fluvial, mieux approprié aux besoins d'échange entre ce littoral de l'Atlantique, d'une part, l'Europe centrale et méridionale de l'autre. Leur préférence en faveur d'une ligne de Lons-le-Saunier à Genève se tire de l'impossibilité d'organiser pratiquement ces communications par le plateau de Pontarlier alors que—tout au contraire—la percée du Jura à proximité de Chagny et de Châlon-sur-Saône, permet de relier aisément le bassin de la Loire à la haute-vallée du Rhône.

4°.—*Groupe du Centre Ouest.*—Les Chambres de Commerce de la région Centre-Ouest qui ont adhéré au projet de la Faucille sont très nombreuses.

En voici la liste:—Alençon, Angers, Angoulême, Bergerac, Blois, Bourges, Châteauroux, Chartres, Cholet, Elbeuf, Evreux, Guéret, Le Mans, Laval, Montluçon, Moulins, Nevers, Poitiers, Rennes, Saumur, Saint-Brieuc.

Presque toutes les délibérations émises par ces compagnies écartent expressément (Montluçon, Nevers, Poitiers, Tours), le tracé, Frasnes-Vallorbes, comme n'ouvrant qu'une porte restreinte, et dont la vallée de la Loire ne bénéficierait jamis vers la Suisse, l'Italie et l'Orient: —"Il n'est pas possible, dit la Chambre de Montluçon, de raccorder utilement soit le rèseau ferré du Centre, soit surtout le réseau navigable, à une ligne ne s'infléchissant pas au-dessous de Dijon. On peut donc avancer, *a priori* que le plus mauvais tracé, au point de vue des intérêts du Centre, est celui qui consiste à utiliser la ligne actuelle Paris-Lausanne, même ramenée à un profil moins défectueux et abrégée de 17 klm., par un raccourci entre Frasne et la gare suisse de Vallorbes—projet qui doit à son économie apparente de rallier certaines adhésions."

La Chambre de Commerce de Nevers, parmi beaucoup d'autres, insiste sur le raccourcissement des distances entre la bassin de la Loire et la région du Léman, qui résulterait du percement de la Faucille.

5°.—*Group de l'Est.*—On eut pu s'attendre à ce que les départements de l'Est, s'inspirant de l'affinité, d'ailleurs purement géographique, qui semble au premier abord, se révéler entre leurs intérêts et le tracé Frasnes-Vallorbes, accordassent à ce tracé la majorité de leurs suffrages. Il n'en a rien été. Seules, les Chambres de Commerce de Gray et de Beszançon se sont prononcées en faveur de Frasnes.

La Faucille, dans le même groupe, a réuni les adhésions de Chambres de Commerce suivantes:—Auxerre, Beaune, Belfort, Châlons-sur-Marne, Dijon, Epinal, Lons-le-Saunier, Reims, Sens, Troyes.

La situation du col du Simplon est beaucoup moins avantageuse pour l'Allemagne que celle du St. Gothard, dit la Chambre de Commerce de Châlons-sur-Marne. L'accès du Simplon est tourné vers la France; c'est la vallée du Rhône; Bonaparte l'avait déjà compris, quand il en fit la principale et la plus courte voie de communication de Paris à Milan. On peut dire à cet égard, que Genève est la porte du Simplon, et que l'Etat qui pourra arriver le plus commodément et le plus rapidement, en aura, pour ainsi dire, la clef. Mais il y a, entre Genève et nous, un obstacle, moins sérieux que celui des Alpes, mais qui, par sa configuration en lignes paralleles, n'en constitue pas moins un rempart assez difficile à percer, c'est le Jura.

L'adhésion de la Chambre de Dijon a d'autant plus de prix que Dijon se trouve placé au point d'intersection des lignes quelconques qui, du côté français, permettent d'aboutir au Simplon. C'est cependant avec une extrême énergie que le rapporteur se prononce en faveur de la Faucille.

Voici quelques passages de ce document.

"Le projet du percement de la Faucille est réclamé par la majorité en France. Il ne rencontre d'adversaires que dans les régions qui se verraient délaissées et dont les intérêts seraient lésés par son adoption. Ces intérêts, quelque respectables qu'ils soient, ne sont toutefois que des intérêts particuliers, qui doivent fléchir devant les intérêts généraux de la nation.

* * * *

"Si nous considérons ce qui se passe autour de nous, si nous regardons, si nous estimons les énormes sacrifices que s'imposent les nations voisines pour le développement, sur leur sol, des moyens de transport, qui constituent aujourd'hui une des principales questions vitales des nations; si nous examinons ce qui se fait en Allemagne, en Suisse et même en Belgique, où l'Etat vient de décider la construction d'une gare centrale à Bruxelles, pour laquelle il va consacrer une somme presque équivalente à ce que

coûtera la ligne de la Faucille, nous avons l'entière conviction, arrêtée d'ailleurs depuis longtemps dans nos esprits que la France ne peut rester plus longtemps en arrière, et qu'elle se doit à elle-même de défendre par les moyens les plus énergiques ses intérêts menacés."

6°.—*Groupe du Midi.*—Ce sont à l'évidence des considérations du même ordre, c'est-à-dire indemnes de tout esprit de particularisme régional, qui ont valu aux projet de la Faucille le suffrage des Chambres de Commerce suivantes:—Agen, Aubenas, Castres, Montauban, Nice, Perpignan, Tarbes, Toulouse.

En rapprochant cette liste de précédentes, on est amené à conclure qu'il n'est, à cette heure, pas une région de la France, si éloignée soit-elle de la zône immédiatement intéressée au percement du Jura, où ce projet n'ait rencontré des partisans, en tant qu'expression de la vérité technique et économique. C'est là un succès moral dont il convient dès aujourd'hui de prendre acte. D'autres suivront.

Nous ne pouvons passer sous silence également l'opinion de M. Emile Perrot, Professeur à l'Université de Paris, qui dans une conférence récemment faite dans cette ville s'exprimait ainsi :—

"Les conditions générales de l'existence des peuples sont, comme celles des individus, soumises à des variations qui, pour être lentes, n'en sont pas moins sensibles: l'évolution est la loi qui régit le monde vivant tout entier. La lutte pour la vie qui jadis se manifesta entre les diverses races par des guerres homicides, semble devoir, de nos jours, prendre un tout autre caractère, du moins chez les nations civilisées: les batailles se liveront désormais sur le terrain économique.

"A l'abri du formidable attirail de guerre, qui ressemble à quelque jouet terrible dont personne n'ose se servir, les nations européennes cherchant non seulement à se devancer l'une l'autre dans la conquête économique de régions nouvelles, mais bien encore, par l'emploi des méthodes les plus variées, à attirer chez elles le mouvement commercial de leurs voisines moins favorisées par leur position géographique.

"Laissant à dessein de ce côté la question de l'expansion coloniale, nous ne nous occuperons pour l'instant que du mouvement commercial et industriel de l'Europe et plus particulierement de celui de notre pays.

"A la suite d'événements malheureux encore présents à la mémoire de la plupart d'entre nous, la France vaincue, écrasée par la force et le nombre, disparaissait momentanément comme puissance militaire de l'échiquier européen. La conséquence morale de cette chute fut le développement inouf, sans précédent dans l'histoire, de la Confédération germanique, groupement assez hétérogene dans doute, mais dont les divers éléments, mûs par le même esprit de haine et de vengeance contre un ennemi de plus d'un demi siècle, avaient réussi à se grouper dans un commun effort pour l'écrasement, qu'ils escomptaient définitif, de notre beau pays de France. Le colosse germanique se dressait désormais à nos côtés, et nous payions bien cher la gloire de deux périodes d'Empire et les fautes de la Restauration.

"La Jeune Allemagne, invulnérable grâce à sa puissante organisation militaire, ne rêva qu'une chose : devenir la nation la plus industrielle du monde. L'œuvre était gigantesque et, nous devons bien l'avouer, les efforts sans cesse dirigés avec un remarquable ensemble de vues dans cet ordre d'idées, furent couronnés d'un succès dépassant les plus magnifiques espérances.

"Pendant ce temps, la France, avec une vitalité insoupçonnée se mit à la besogne, pansa sa large blessure, réorganisa ses finances, son armée, sa marine, etc., et stupéfia le monde par la rapidité avec laquelle elle se trouva bientôt prête à faire de nouveau face aux événements. Mais, hélas! il fallait compter avec les conquêtes économiques de sa terrible voisine, et notre pays se trouvait pour toujours en présence d'un concurrent des plus redoubtables, à qui son magnifique élan avait donnê dix annése d'avance. Il est nécessare aussi d'ajouter que les méthodes scientifiques commerciales prévalurent dès l'abord partout en Allemagne, tandis qu'actuellement l'intérêt de ces méthodes échappe encore à bon nombre de nos industriels.

"Grâce à l'extraordinaire développement de ces voies navigables intérieures, et à l'extension énorme de ses chemins de fer, convergeant vers la Baltique, l'Allemagne imposa son influence prépondérante à toute l'Europe centrale et Hambourg devenait en peu d'années l'un des premiers ports commerciaux de notre vieux monde.

"Il n'est pas jusqu'au percement du St. Gothard qui ne devait enlever annuellement à la France un trafic approchant 50 millions, soit près d'un milliard depuis l'ouverture du tunnel. Insister encore sur les résultats acquis serait trop cruel pour notre amour propre national!

"Est-ce à dire nous sommes restés impassibles devant cette evolution: Non, certes, mais il faut avouer cependant que nous avons bien fait peu de chose, et que si de nombreux travaux furent entrepris pour mettre la France en état de résister, il leur manqua cette remarquable unité de direction qui fait la caractéristique de l'évolution commerciale de nos voisins d'outre-Rhin.

"Peut-être avons-nous trop sacrifié à l'expansion coloniale, et il semble que la dernière législature l'ait fort bien compris en donnant son approbation entière à des projets de gigantesques travaux intérieurs, dont il nous est permis d'espérer la prochaine réalisation.

"Notre réseau de canaux et de voies ferrés va s'augmenter considérablement, et nous avons vu de nouveau s'agiter sérieusement des questions qui interessent au plus haut degré le trafic commercial. Il

n'est aucun Français qui n'ait entendu parler de Paris-Port-de-mer, de la navigation de la Loire, et même des différents rapports traitant la question du canal des Deux-Mers.

"Devant l'impossibilité d'une réalisation simultanée, il importe de prendre une décision et de se mettre courageusement à l'œuvre pour la réalisation du projet que doit nous apporter le plus rapidement possible des résultats réellement pratiques.

"Inutile d'ajouter qui si le parcours français est rendu plus aisé, la malle des Indes n'hésitera pas à se servir de la nouvelle voie où elle rencontrera des conditions d'établisement favorisant la rapidité et la facilité d'accés et raccourcissant son parcours total. Il n'est pas jusqu'aux relations internationales qui ne puissent gagner à l'amélioration de notre réseau du Jura. L'Angleterre ne doit-elle pas diminuer la distance qui la sépare de Brindisi et de Suez, et l'Italie intéressée à se rapprocher commercialement de la France n'escompte-t-elle pas avec une satisfaction non dissimulée, les bénéfices que pourra lui procurer l'établissement de cette artère économique nouvelle ?

"Aussi, à Londres comme à Rome, ces projets reçoivent, nous le savons, les plus hauts encouragements."

Un tel mouvement général d'opinions entraîna une enquête sérieuse faite par M. Trouillot présentement Ministre du Commerce et de l'Industrie en France. Il en est résulté que 81 Chambres de Commerce et 37 Départements se sont raliés au projet. M. le Ministre Trouillot en a informé son collègue M. le Ministre des Travaux Publics par une lettre en date du 23 Octobre 1902 dans laquelle nous relevons les passages suivants :—

"L'analyse des dossiers transmis à mon Départment m'a fait connaître que les motifs sur lesquels la très grande majorité des Assemblées départmentales ou des Compagnies consultées fondent leurs préférences pour le tracé Lons-le-Saulnier à Genève peuvent se ramener à trois principales :

1°. Nécessité d'établir vers la Suisse, l'Italie et l'Orient, fut-ce au prix de sacrifices financiers, une artére irréprochable, non seulement la plus courte possible, mais se dérobant, par ses qualités d'altitude et de profil, aux inconvénients ordinaires des lignes de montagne.

"Presque toutes les Assemblées ou Compagnies consultées considèrent que seule une ligne directe de Paris à Milan, par Lons-le-Saulnier, Genève et le Simplon, ne dépassant pas la côte 559 et ne comportant que des rampes inférieures à 10 o/oo, permettra aux Compagnies françaises de faire une concurrence efficace."

Soit à la ligne du Saint-Gothard (trafic anglo-italien et italo-belge) :

"Soit à l'artère en perspective avec Ostende-Vienne-Solonique (trafic d'Angleterre en Orient et services assurés par la Malle des Indes).

"2°.—Nécessité d'étendre l'influence du Simplon à une zone française aussi large que possible, et non pas seulemeut comme il résulterait du choix d'une voie d'accès par le plateau de Pontarlier—à Paris, à nos ports du Nord et à la région Nord-Est."

L'Italie qui a voté en Décembre 1901 une somme de 46 millions de francs pour ses lignes d'accès du versant Sud du Simplon, voit avec grande sympathie le mouvement qui se dessine en France en faveur de la ligne de Lons-le-Saulnier-Genève. Cette artère est seule susceptible en effet de lui amener un nouveau courant commercial digne des sacrifices auxquels elle vient de s'imposer. La dépense pour créer la ligne qui aurait 7 petits tunnels de moins de 1,000 mètres, deux respectivement de 1,100 et 6,400 mètres et enfin deux grands tunnels de 11,400 et 15,200 mètres a été estimée par les ingénieurs à une somme ne pouvant dépasser 100 millions de francs. La participation financière de tous les intéressés n'a pas encore été établie.

Enfin toutes ces recherches et toutes ces constatations trouveront leur complément dans l'Enquête que M. le Ministre du Commerce de France a confiée dernièrement à M. Louis Laffitte un spécialiste dont les travaux économiques font autorité.

IV.—La Nouvelle Ligne Internationale Anglo-Italienne Pour L'Orient.

Il est certain que la route de Suez reste pour toutes les grandes nations européennes un point désigné pour la stratégie commerciale et que Salonique en est le port du continent le plus rapproché. La politique de l'Autriche-Hongrie vise, dit-on, à l'englober dans le système économique de l'Europe Centrale. Quel en serait le résultat ? Uneconcurrence entre Salonique tête d'une ligne transcontinentale. des côtes de la mer du Nord à Suez, et Brindisi, tête d'une ligne Anglo-franco-italienne.

Si l'on examine la carte de la péninsule balkanique, il est aisé de constater, qu'entre la voie ferrée qui remonte de Salonique à Mitrovitza par la vallée du Vardar et celles qui descendent de Vienne sur Serajevo par la vallée de la Save, il existe une solution de continuité. Le projet austro-hongrois consiste à relier ces deux points, Serajevo et Mitrovitza. Quelle serait la portée de cette nouvelle ligne au point de vue du trafic iaternationnl ? Elle constituera un instrument de pénétration de l'influence austro-hongroise, sur cette partie

du territoire Ottoman. Le passage sur le territoire serbe étant évité et le seul fait que l'Empire Ottoman consentira, ce qui est tout à fait probable au raccord par Mitrovitza, indiquera par avance sa soumission aux vues de l'Autriche. Derrière les intérêts de cette puissance, il y a aussi ceux de l'Allemagne. Nul n'ignore avec quelle hardiesse cette dernière puissance a récemment affirmé les tendances commerciales de sa politique en Orient. Ne mettrait-elle pas à profit ses relations avec l'Autriche-Hongrie pour donner un maximum d'efficacité à la ligne qui lui offre un débouché sur Salonique et pour concourir au besoin à faire de cette ligne l'équivalent pour l'Europe central, de ce qu'est l'artère italienne pour les pays occidentaux? Emus de la perspective d'une poussée austro-allemande vers les Balkans, les Etats balkaniques ont une réponse toute prête sous la forme du rattachement direct du Danube á l'Adriatique, de Kladovo par Nisch et Scutari à Antivari, qui constituerait la ligne transbalkanique dite "voie du Sud."

La distance actuelle de Londres à Nisch par Ostende et l'Allemagne est de 2,507 kilomètres. Si l'on réalise les projets de la Faucille et du Transbalkanique la distance s'établira par la voie du Sud comme suit:—

De Londres à Paris	..	456 kilomètres
,, Paris à Milan ..	..	870 ,,
,, Milan à Venise ..	..	265 ,,
,, Venise à Antivari	..	750 ,,
,, d'Antivari à Nisch	..	400 ,,
		2,741 kilomètres.

Mais le parcours par eau devant être réduit des deux tiers au point de vue de la tarification, cette distance par la seule utilisation de l'Adriatique se ramènerait à 2,241 kilomètres.

Si la voie navigable entre le Lac Majeur et Venise est établie, faisant partie du programme des grands travaux publics de l'Italie, cette distance serait réduite encore à 2,000 kilomètres environ.

Le mouvement commercial de l'Angleterre vers ces régions au lieu de passer par Cologne et Vienne, emprunterait une des lignes françaises de Calais ou du Hâvre à Genève, soit par Troyes et Dijon soit par Nancy Belfort et Lons-le-Saunier, soit par Paris. Les exportations d'Angleterre sont importantes, pour l'Empire Ottoman elles s'élèvent à environ 190 millions de francs, pour la Roumanie à 73, pour la Bulgarie à 18, pour la Serbie à 4, et à présumer elles s'augmenteraient encore considerablement.

Le Simplon sera donc un nouveau passage d'Occident en Orient et plus on réduira au minimum la distance entre Calais et Brindisi, plus vite sera créée la grande ligne de communications entre l'Angleterre et l'Orient asiatique.

Sans vouloir anticiper sur les événements, il est certain pour le moment, aussitôt le Tunnel du Simplon construit, que la ligne du Simplon sera choisie par les grands express internationaux faisant tête à Brindisi, à Naples, à Gênes, c'est-á-dire à de grands ports d'embarquements pour l'Egypte, Suez, &c.

Entre le Gothard et le Simplon il n'y aura pour le commerce anglais de préférence que pour la ligne de transit la plus courte au point de vue de la vitesse.

Les chiffres suivants permettent donc d'accorder large crédit au futur trafic anglo-italien pour la ligne de la Faucille.

	Distances.	
	Réelles.	Virtuelles.
Ostende-Milan (Gothard)	1,036	1,195
Calais-Milan (Faucille-Simplon) ..	1,168	1,234
Ostende-Gênes (Gothard)	1,207	1,366*
Calais-Gênes (Faucille-Simplon) ..	1,301	1,367*

Les chiffres qui viennent d'être fournis démoignent dans quelle mesure les communications rapides entre la France et l'Italie, l'Angleterre et Brindisi seraient améliorées, surtout si ce dernier port subit les changements qui sont à l'étude actuellement. La traversée de la Manche étant de 78 kilomètres plus courte par Calais que par Ostende et ensuite l'altitude du Gothard (1,154 mètres) ne pouvant assurer en hiver une exploitation aussi rapide et aussi régulière que celle d'une ligne passant à 700 mètres sous le Simplon et à 559 sous le Jura, tout porte à désigner la nouvelle voie projetée comme la grande porte future de circulation entre l'Angleterre et l'Italie.

La Chambre de Commerce française de Londres a examiné très attentivement cette question et par la plume de son dévoué secrétaire M. Clerc elle s'est exprimée ainsi:

"Si donc la France veut reconquérir sa vraie destination économique qui est de servir de trait d'union entre l'Angleterre, la Suisse et l'Italie et même l'Orient, qu'il nous soit permis d'espérer que dans le débat qui aura lieu au Parlement français au sujet

* Ces deux distances doivent virtuellement subir une majoration égale pour le passage des Apennins.

Londres-Ostende, 236 kilom.

Londres-Calais, 158 kilom.

Londres-Gênes (Gothard), 1,366 + 236 = 1,602.

Londres-Gênes, 1,367 + 158 = 1,525 soit 77 kilom. en faveur du Faucille-Simplon.

du choix des lignes à créer, la France n'ait pas d'autre préoccupation que celle de servir utilement les 'intérêts supérieurs' du pays."

A Genève nous avons été heureux de recevoir ce témoignage emanant d'un millieu d'une autorité et d'une compétence telles. Le fait d'être à la fois une Chambre française et de représenter des intérêts français à Londres donne à ce jugement la valeur d'une sanction décisive. Il vient d'être confirmé d'ailleurs par une délibération judicieusement motiveé de la Chambre de Commerce française de Milan.

Messieurs,—Vous avez en Angleterre des économistes distingués, aussi, si cette conférence, quoique très imparfaite, pouvait mettre en lumière l'importance de ce nouveau projet de ligne internationale, et trouvait quelque écho dans ce pays où l'on possède à un si haut degré l'intelligence des affaires, je n'aurai qu' âme féliciter de la bienveillante attention que vous avez bien voulu m'accorder.

DISCUSSION.

The CHAIRMAN, on behalf of the members, expressed their admiration of the clear and lucid way in which the author had brought the subject forward. Colonel Turrettini, whose photograph had been shown, was well known in London, having been a member of the Commission appointed to determine the advisability of constructing the great engineering works at Niagara. The paper was an illustration of what might be called the peaceful war of nations. All the nations on the Continent were vieing with each other, and doing all they possibly could to expedite the transit between the West and the East. Not only would passengers save two very valuable hours, and travel in greater comfort, but the gigantic and increasing commerce between the East and West would be benefited by the shorter route, and India, Burma, Siam, China, and Japan would offer improved markets in the future to the Western manufacturers. A few of the novelties mentioned by Dr. Goegg were extremely interesting from an engineering point of view. The designers of the work had gone back to first principles. The first principle enunciated in this country by the great engineer who projected the railway system, George Stephenson, was that a line should be constructed, not as straight, but as level as possible, the reduction of gradients, even at the expense of distance, meaning often speed. All the lines laid out by George Stephenson, the London and Brighton, the London and Birmingham, the Liverpool and Manchester, and others possessed that characteristic, while the other lines of the country constructed during the great railway mania of 1845-6 were up hill and down dale, long, tedious, shaky, and uncomfortable. A new and most important principle in piercing high and long mountains had been introduced, viz., the construction of two tunnels instead of one. The great trouble in all long tunnels was the question of ventilation, which was very much exaggerated by two trains running in opposite directions through the tunnel. With two tunnels and one train always running in the same direction that problem would be considerably diminished. One point touched on which would probably attract much attention was the high temperature experienced in piercing the tunnel, *i.e.*, 50° C. or 122° Fahr. The possibility of having to travel through such a temperature made one perspire at the very idea. Fortunately this temperature was only experienced while the tunnel was being constructed, and with good ventilation and cold water, of which there was a great abundance, the probability was it would not prove a serious difficulty, especially if, as suggested in the paper, the line was worked by electric traction. The great trouble in long tunnels at the present time was not so much the temperature but the fact that the air was saturated with the products of the combustion from the coal of the locomotive, and there were cases on record of drivers being asphyxiated by the nauseous atmosphere through which they had to pass. Electric traction, amongst its other immense advantages, would sweep away all such difficulties, with the result that not only would passengers have a shorter journey, but the comfort of travelling would be considerably increased. It had been stated that in the station at Rome there was a tablet erected to the memory of George Stephenson, who asserted that, in days of old, it was the motto of every Roman that all roads led to Rome, implying that now that Stephenson had shown what a railway could do the end would be that engineering science would again lead all roads to Rome. He was afraid, from what was said in the paper, that the Swiss would disappoint the Italians, for all roads would not lead to Rome, but away from Rome, and if they led anywhere it would be to Egypt.

Prof. LE NEVE FOSTER, F.R.S., enquired whether Dr. Goegg was strictly correct in asserting that the rate of progress in driving the tunnel was seven, eight, or ten mètres a day. From his recollection of some figures he had seen at the Düsseldorf Exhibition, he believed the rate last year at the north end was about $6\frac{1}{3}$ metres, or 21 feet a day, a splendid rate of progress, but not so large as that mentioned. It was most interesting to notice from a mining point of view that one scourge of mining, silicious dust, a scourge which had produced dire effects in the Transvaal, had been remedied by the method of driving employed in the Simplon tunnel. By the use of a drill driven by hydraulic power, with a current of water continually running through it, no dust whatever was produced. He did not mean

to assert that it would necessarily be advisable commercially to employ the same method of driving in the Transvaal, because that matter would have to be investigated on the spot, but it was well to know that a remedy had been found for so great an evil. Dealing wiih temperature, he thought Dr. Goegg would be able to state that 50° C. was not the temperature of the air in the tunnel in which the men were working, but that of the rock on the sides of the tunnel, the temperature in which the men worked being considerably less than that figure. There need not be the slightest apprehension of travelling through the tunnel on that score, because in India, the temperature in the railway cars often exceeded 100° Fahr. He thought civil engineers might be reminded that in ventilating by means of two separate tunnels, they were simply copying the old plan adopted by coal miners who, when they were driving their tunnels from the bottom of the shaft, drove two tunnels, thus obtaining ventilation.

Dr. Goegg, replying to Dr. Le Neve Foster in French, stated that, at the present moment, the average advance, taking both sides—the Italian and Swiss—together, was at the rate of 12 metres per day. The rock on the Italian side was, however, harder, and the rate of progress on that side was necessarily less, sometimes not exceeding three or four metres per day, thus reducing the average. With respect to the sanitary and other arrangements made for the welfare of the working population at the seat of the works, he stated that elaborate sanitary and hygienic appliances were provided, owing to which the general condition of health had lately improved in a remarkable degree. The ankylostomiasis which had been prevalent among the workers in the St. Gotthard tunnel was quite unknown among those of the Simplon. Strict rules as to cleanliness, baths, &c., were enforced, and excessive fatigue avoided; the men being expected to work only four hours a day.

Mr. John Leighton contrasted the inconveniences suffered by travellers in the heavy diligences, a few years ago, with the shorter and more comfortable journey which would be possible by the new route.

M. Eugène Payart (speaking in French) said that the scheme which Dr. Goegg had described commanded his fullest sympathies and best wishes. Whilst cordially supporting Dr. Goegg he called attention to the fact that the scheme had already been referred to at the International Congress of Economic and Commercial Geography, which met at Paris, between August 27th and August 30th, 1900, by M. de Claparède, President of the Geneva Geographical Society, who described this new Simplon line as being "the shortest route between Paris and Milan." The line was to extend through the Jura by two tunnels, 11,400 metres and 15,200 metres in length, respectively, the maximum altitude being 559 metres. The speaker pointed out that the new line was not merely, as was then claimed to be, the most direct and rapid route between Paris and Milan, but that in reality it represented, as Dr. Goegg had - self pointed out, a shortened route between the extreme points, Calais and Brindisi.

Mr. Leon Gaster inquired what was the nature of the rock through which the tunnel was pierced, because it was a well-known fact that that had an influence on the temperature.

Dr. Goegg said that the rock was a species of granite known as Antigorio gneiss. In acknowledging the vote of thanks, he said that he had known of old how strong a tie of sympathy there had always existed between England and the town of Geneva, and that whenever it should be in his power to strengthen that bond of friendship he should always feel happy to take every opportunity of so doing.

Obituary.

Sir William Chandler Roberts-Austen, K.C.B., F.R.S.—The Society has again to record the loss of one of its most eminent and valued members in Sir William Roberts-Austen, who died on November 22nd, at his official residence in the Royal Mint, at the age of 59. He had been a member of the Society of Arts since 1890, and had served on the Council from 1891 till 1898, and again from 1900 up to the present time. Chandler Roberts, as he was then named, before he took the name of Austen in 1885, entered the Royal School of Mines in 1861, obtaining the Associateship in 1865. His first work was in association with Thomas Graham, the Master of the Mint, whose assistant he was from 1865 to 1869. He assisted Graham very ably in his later researches, and commenced at this period the important investigations in physical metallurgy which have only been interrupted by his death. In 1870 he was appointed chemist to the Mint, and in that capacity he was responsible for the standard fineness of over £117,000,000 of gold coin. In 1880 he succeeded Dr. Percy as Professor of Metallurgy at the Royal School of Mines, an appointment he continued to hold till the time of his death. The discharge, however, of the duties of these two appointments, laborious as they were, did not prevent his carrying on a long series of scientific investigations connected with physical metallurgy, of which the most important were his researches into the structure of metals and alloys, many researches having a most important bearing on their industrial uses. His experimental work on the diffusion of metals was equally brilliant

He was the first to determine quantitatively the rate and amount of diffusion of one metal in another in a series of classical experiments on gold and lead. This formed the subject of the Bakerian lecture of the Royal Society in 1896. The results of this work were also published in a series of reports to the Institution of Mechanical Engineers, for it was at the instance of the Alloys Research Committee of that Institntion that he first began, in the year 1890, to investigate the effects of small admixtures of certain elements on ths mechanical and physical properties of metals.

It was while he was engaged in this research that he invented the Recording Pyrometer, an instrument which has proved of great value, not only for scientific investigation, but also for practical metallurgy. It is used in metallurgical works, not only for laboratory experiments, but for recording the temperature of flues, of annealing and other furnaces, and of the blast for blast furnaces.

His capacity for work also led him to be constantly nominated as a member of departmental and other Committees. Amongst others, he served as Chairman of the Inland Revenue and Customs Laboratoriee Committee, as a member of the Board of Trade Committee on the Deterioration of Steel Rails in 1896, and of the National Physical Laboratory Committee in 1897; besides undertaking such public work as was implied by being a member of the Executive Committee of the Inventions Exhibition in 1885, of the Council of the British Section of the Paris Exhibition in 1889, and of the Royal Commission for the Chicago Exhibition in 1893. Indeed there can be little doubt that it was his devotion to this and other public duties which broke down his health, and ultimately caused his death.

He was made a C.B. in 1890 and a K.C.B. in 1899. He was President of the Iron and Steel Institute (1899—1901), General Secretary of the British Association (1897—1902), Vice-President of the Chemical Society and of the Physical Society, of which he was one of the founders, Honorary Member of the Institution of Civil Engineers and of the Institution of Mechanical Engineers. In 1893 he was elected by the Committee a member of the Athenæum Club for distinguished eminence in science, and in 1890 he received the Legion of Honour from the French Government. He was the author of an "Introduction to the Study of Metallurgy," and of many papers published in the *Philosophical Transactions*, the Journal of the Iron and Steel Institute, the Proceedings of the Institution of Civil Engineers, and the Proceedings of the Institution of Mechanical Engineers.

The Society of Arts has benefited no less than the other Institutions with which he was connected from his energy and public spirit. His work on Alloys is ully recorded in the five series of Cantor lectures on that subject, of which the first was given in 1884 and the last in 1901, and in a somewhat more popular and less technical shape than in his various papers and lectures. He had it in contemplation to re-issue these in the form of a book. He also read two papers before the Society on "Alloys in Art Metal Work," and on "Rare Metals," besides one in association with Mrs. Lea Merritt on "Mural Painting."

He was greatly liked by a large circle of friends, and his intimate associates will long miss the kindly genial humour which—especially in years before the pressure of work began to tell on a somewhat excitable and eager nature—brightened and enlivened all their intercourse with him.

ARRANGEMENTS FOR THE SESSION.

ORDINARY MEETINGS.

DECEMBER 3.—"Some Aspects of Photographic Development." By ALFRED WATKINS. SIR WILLIAM ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., will preside.

DECEMBER 10.—"French Rural Education and its Lessons for England." By CLOUDESLEY BRERETON. LORD REAY, G.C.S.I., G.C.I.E., Chairman of the London School Board, will preside.

DECEMBER 17.—"The South Russian Iron Industry." By ARCHIBALD P. HEAD, Mem.Inst.C.E. MR. WILLIAM EGERTON HUBBARD will preside.

INDIAN SECTION.

DECEMBER 11.—"Domestic Life in Persia." By MISS ELLA C. SYKES. EARL PERCY, M.P., Under Secretary of State for India, will preside.

For Meetings after Christmas :—

"Industrial Trusts." By PROF. W. SMART, LL.D. SIR ROBERT GIFFIN, K.C.B., LL.D., F.R.S., will preside.

"Oil Lighting by Incandescence." By ARTHUR KITSON.

"The Metric System." By A. SONNENSCHEIN.

"The Cost of Municipal Trading." By DIXON H. DAVIES.

"Stage Costumes and Accessories." By PERCY MACQUOID.

"The Principles of Applied Art." By G. F. BODLEY, R.A.

"Modern Movements in Decorative Art." By CHARLES HOLME.

"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo.

"Three Colour Printing." By HARVEY DALZIEL.

"The Port of London." By Dr. B. W. GINSBURG.

"Tonkin, Yunnan and Burma." By FRED. W. CAREY, late H.B.M.'s Acting Consul at Szemao, China.

Indian Section.

The meetings of this Section will take place on the following Thursday afternoons, at 4.30 o'clock:—

December 11, January 22, February 12, March 12, April 23, May 14.

Colonial Section.

The meetings of this Section will take place on the following Tuesday afternoons, at 4.30 o'clock:—

January 13, February 24, March 31, May 5.

Applied Art Section.

The meetings of this Section will take place on the following Tuesdays, at 4.30 or 8 o'clock:—

January 20, February 3, 17, March 17, April 21, May 19.

Cantor Lectures.

The following course of Cantor Lectures will be delivered on Monday Evenings, at 8 o'clock:—

Prof. Vivian B. Lewes, "The Future of Coal Gas and Allied Illuminants." Four Lectures.

Lecture II.—December 1.—The dilution of coal gas by gases cheaply produced by other processes—The effect of lowering candle power on the calorific value of the gas—The photometry of low-grade gas and the conditions under which its illuminating power is best developed.

MEETINGS FOR THE ENSUING WEEK.

Monday, Dec. 1...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. Vivian B. Lewes, "The Future of Coal Gas and Allied Illuminants." (Lecture II.)

Royal Institution, Albemarle-street, W., 5 p.m, General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Charles H. W. Biggs, "Depreciation of Plant and Works under Municipal and Company Management."

Chemical Industry (London Section), Burlington house, W., 8 p.m. 1. Mr. Arthur Marshall, "The Influence of Impurities on the Specific Gravity of Sulphuric Acid." 2. Messrs. R. Forbes Carpenter and J. E. Linder, "The interaction of Sulphurous and Nitrous Acids as affecting various Absorbents employed in Testing the Gases escaping from Vitriol Chambers." 3. Mr. Arthur Marshall, "Note on the Determination of the Strength of Sulphuric Acid."

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. Cutliff Hyne, "Arctic Lapland."

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. T. G. Pinches, "The Babylonian Story of the Creation."

London Institution, Finsbury-circus, E.C., 5 p.m. Pro . Silvanus P. Thompson, "The Magic Mirror."

Tuesday, Dec. 2....Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Thomas Herbert Minshall, "High Speed Electrical Generating Plant."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Dr. Hans Gadow, "Features of Animal Life in Southern Mexico. 2. Dr. Einar Lönnberg, "The Variation of the Elk." 3. Mr. W. F. Lanchester, "The Crustacea collected during the 'Skeat Expedition' to the Malay Peninsula," (Part II.)

Wednesday, Dec. 3...SOCIETY OF ARTS, John-street, Adelphi. W.C., 8 p.m. Mr. Alfred Watkins, "Some Aspects of Photographic Development."

Geological, Burlington-house, W., 8 p.m.

Royal Archæological Institute, 20, Hanover-square, W., 4 p.m. 1. Mr. C. R. Peers, "Benedictine Nunnery at Little Marlow." 2. Messrs. F. W. Reader and A. S. Kennard, "Pile Structures near London Wall."

United Service Institution, Whitehall, S.W., 3 p.m. Mr. H. N. Sulivan, "The Use of Vertical Fire from the Sea against Ships and Dockyards."

Entomological, 11, Chandos-street, W., 7 p.m.

Archæological Association, 32, Sackville-street, W., 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

Thursday, Dec. 4...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. G. C. Bourne, "New and rare Corals from Funafuti." 2. Mr. E. A. Newell Arber, "The Morphology of the Flowers and Fruits of the *Xylosteum* section of *Lonicera*. 3. Mr. C. B. Clarke, "Note on *Carex Tolmiei*, Boott." 4. Mr. C. With, "New and Old Phalangiodes from the Indian Peninsula."

Chemical, Burlington-house, W., 8 p.m. 1. Mr. W. N. Hartley, "The Absorption Spectra of Metallic Nitrates." (Part II.) 2. Mr. H. Crompton, "The Specific Heats of Liquids." 3. Mr. M. O. Forster, "Studies in the Camphane Series." (Part X.) "The constitntion of Enolic Benzoylcamphor." 4. Mr. M. O. Forster, "Note on the Isomeric Benzoyl Derivatives from Isomtrosocamphor." 5. Messrs. J. B. Cohen and H. D. Dakin, "The constitution of the Products of Nitration of Meta-acetoluidide."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. R. Kerr, "Colour Photography."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Inaugural Address by the President, Mr. Swinburne.

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. A. W. Manton, "Some Notes on Tunnelling."

Friday, Dec. 5...Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. A. Reynolds, "The Erection of Steel Bridges, Sheffield Extension of the London and North-Western Railway."

Geologists Association, University College W.C., 8 p.m. 1. Miss Catherine A. Raisin, "The Formation of Chert." 2. Mr. A. K. Coomaraswamy, "A List of the Fish Remains from the Middle Bagshot Beds of the London Basin."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Saturday, Dec. 6...Waterworks Engineers, Geological Society's Rooms, Burlington-house, W., 10½ a.m. 1. Mr. W. H. Humphreys, "The Coating of Cast Iron Water Pipes." 2. Mr. T. Molyneux, "Description of Softening Plant at Wilmslow: Stockport Corporation Works." 3. Mr. John Shaw, "The Detection and Prevention of Underground Pollution."

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FRIDAY, DECEMBER 5, 1902.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, December 8, 8 p.m. (Cantor Lecture.) Professor Vivian B. Lewes, "The Future of Coal Gas and Allied Illuminants." (Lecture III.)

Wednesday, December 10, 8 p.m. (Ordinary Meeting.) Cloudesley Brereton, "French Rural Education and its Lessons for England."

Thursday, December 11, 4.30 p.m. (Indian Section.) Miss Ella C. Sykes, "Domestic Life in Persia."

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, December 31st and January 7th, at 5 o'clock, by Professor Edward B. Poulton, M.A., D.Sc., F.R.S. (Hope Professor of Zoology in the University of Oxford), on the "Means of Defence in the Struggle for Life among Animals."

Lecture I.—"The Methods by which Animals hide in order to escape their Enemies and catch their Prey."

Lecture II.—"The Ways in which Animals warn their Enemies and signal to their Friends."

Members who desire tickets for the course are requested to apply for them at once.

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

CANTOR LECTURES.

Professor Vivian B. Lewes delivered the second lecture of his course on "The Future of Coal Gas and Allied Illuminants," on Monday evening, 1st inst.

The lectures will be printed in the *Journal* during the Christmas recess.

Proceedings of the Society.

THIRD ORDINARY MEETING.

Wednesday, December 3, 1902; Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Edwards, Reginald William, Brooklands, Church-lane, Aldershot.

Niles, Marston, 140, Nassau-street, New York City, U.S.A.

Saenz de Zumaran, Alfonso, Chargé d'Affaires de l'Uruguay, Legation Office, 104, Victoria-street, Westminster, S.W.

Vigor, Rupert H., 15 and 17, King-street, West India Dock-road, Poplar, E.

Visick, Charles, A.M.I.Mech.E., Messrs. W. Visick and Sons, Basset Works, Devoran, Cornwall.

Wyatt, T. G., North Clifton Plumbing and Engineering Works, Guernsey, Channel Islands.

The following candidates were balloted for and duly elected members of the Society:—

Aldrich, Orlando Wesley, M.A., D.C.L., LL.D., Ph.D., Room 11, Wesley Block, Columbus, Ohio, U.S.A.

Allen, F. Bowen, M.A., B.Sc., Director, School of Mines, Coolgardie, Western Australia.

Argollo, Miguel, M.Inst.C.E., San Francisco Railway, Alagoinhas, Bahia, Brazil, South America.

Armstrong, M. F., 8, Upper Wimpole-street, W.

Aronson, Adolph, 39, Foster-lane, E.C.

Bandinel, J. J. Frederick, B.A., Newchwang, North China.

Barr, Mark, 25, Kensington-court-gardens, W.

Beauchamp, Earl, K.C.M.G., Madresfield-court, Malvern Link.

Beck, Isaac, M.I.Mech.E., Haymarket-chambers, 17, Haymarket, Sheffield.

Begbie, Ernest, De Beers Consolidated Mines, Ltd., P.O. Box 195, Salisbury, Rhodesia, South Africa.

Behr, H. C., The Consolidated Gold Fields of South Africa, Limited, P.O. Box 1167, Johannesburg, Transvaal, South Africa.
Bensusan, S. L., M.Inst.M.M., Equitable-building, Sydney, Australia.
Bhatt, Parvatiprasad Vishvanath, 55, Blenheim-crescent, Notting-hill, W.
Body, John Benjamin, M.Inst.C.E., Puente de Alvarado 15, Mexico City.
Bose, S., Deputy Superintendent, Central Jail, Jubbulpore, India.
Bostwick, H. R., Messrs. Collbran and Bostwick, Seoul, Korea.
Bott, John, 37, Herne-hill, S.E.
Bower, Edw. H. M., Port Office, Calingapatam, Ganjam District, India.
Brebner, Captain Charles William, Villa des Roses, Rose-hill, Mauritius.
Brelich, Henry, A.R.S.M., care of Messrs. Arnhold, Karberg and Co., Hankow, China.
Browne, Hon. John E. D., The Neale House, The Neale, co. Mayo, Ireland.
Brownell, Clarence Ludlow, 21, Hermitage-road, Richmond, Surrey.
Budge, Edward Barnard, B.Sc., M.Am.Soc.C.E., Engineer in Chief, 1st Section, Chili State Railways (F. C. del E.), Estacion Bella Vista, Valparaiso, Chili, South America.
Bullen, William Henry Chambers, 15, St. John's-road, Richmond, Surrey.
Burt, George Stephen, F.S.S., 4, Lothbury, E.C.
Butcher, Charles Ernest, 273, Finchley-road, South Hampstead, N.W.
Buxton, John Henry, Senr., Clumber - cottage, Montague-road, Felixstowe, Suffolk.
Campbell, David B., 112, Clifton-park Avenue, Belfast.
Carolis, W. D., 18, Kayman's-gate, Colombo, Ceylon.
Chapman, Walter William, F.S.S., 5, Claremont-road, Tunbridge Wells.
Chetty, Rao Saheb T. Namberumal, B.A., 144-5, China Bazaar-street, Sowcarpett, Madras, India.
Close, Henry Gaskell, 101, Eaton-square, S.W.
Dana, Prof. Charles Edmund, 2013, De Lancey-place, Philadelphia, U.S.A.
Danvers, Ernesto, F.S.S., M.Inst.E.E., 475, Piedad, Buenos Aires, South America.
Das, Hari Das, Raghunathganj, Murshedabad, India.
Davy, Joseph Burtt, Cosmos Club, Washington, D.C., U.S.A., and College of Commerce, University of California, U.S.A.
Daw, Frederick R. Williams, The New Zealand Crown Mines Company, Limited, Karangahake, near Auckland, New Zealand.
Deerhurst, Viscount, Dynes Hall, Halstead, Essex.
De Marillac, Count Ernst, Wynberg, Cape Colony, South Africa.
Desborough, Captain Arthur P. H., R.A., Home Office, Whitehall, S.W.
Donnelly, Francis, M.S.Chem.Industry, 335, Hyde-road, Ardwick, Manchester.
Donovan, Fergus, Royal Colonial Institute, Northumberland-avenue, W.C.
Douslin, H. B., Public Works Department, Matabeleland District, Rhodesia, South Africa.
Dunham, Henry V., Casein Company of America, 37, Scheepmakershaven, Rotterdam, Holland.
Edwards, Arthur M., Barncote, Reigate, Surrey.
Ellis, Frederic Richard, F.C.S., 15, Shadwell-road, Bishopston, Bristol.
Etherington, John Francis, Hersham, Surrey.
Fowler, George William, Mossel Bay, Cape Colony, South Africa.
Gallagher, J. Walter, Bangkok, Siam.
Gheury, Maurice Edmund Joseph, F.P.S., 12, Cressy-road, Hampstead, N.W.
Gilfillan, W. H., Surveyor-General's Department, Pretoria, Transvaal, South Africa.
Gilkison, T. T., Mombasa, East Coast of Africa.
Girouard, Lieut.-Colonel Sir Edouard Percy, K.C.M.G., D.S.O., Johannesburg, Transvaal, South Africa.
Gleed, Richard C., Flodden-house, 21, Flodden-road, S.E.
Goldblatt, D., Cape Town, South Africa.
Goold, William Tom, M.I.Mech.E., Tuthill-house, Lydney, Gloucestershire.
Gray, Robert Whytlaw, 7, Orme-court, W.
Halcrow, James Benjamin, 56, West-side, Wandsworth-common, S.W., and 5, Moorgate-street-buildings, E.C.
Hamilton, John James, 1, Barkston-gardens, S.W.
Hardy, James Henry, The Municipal Technical School, Halifax.
Harper, Edgar Josiah, County-hall, Spring-gardens, S.W.
Harris, Morrie J., Municipal Surveyor, Mafeking, Cape Colony, South Africa.
Hawkesley, Charles, M.Inst.C.E., 30, Great George-street, S.W.
Hawkins, Edward, Manor Estate, Sidcup, Kent.
Henriques, Cecil Quixam, M.I.Mech.E., 59, Sussex-gardens, Hyde-park, W., and 15, Victoria-street, Westminster, S.W.
Heyer, A. E., Rosebank, Cape Town, South Africa.
Hill, Walter Wellesley, Admiralty Harbour of Refuge Works, Peterhead, N.B.
Hilton, Ernest Frederick, 23, The Boltons, South Kensington, S.W., and Constitutional Club, W.C.
Hipwell-Howitt, Arthur George, 2, Studdridge-street, Hurlingham, S.W.
Hke, Saw, Hsipaw Sawbwa Gyi, Hsipaw, Northern Shan States, Burma.
Hoffmann, John J., M.Inst.M.M., Rand Club, Johannesburg, Transvaal, South Africa.
Horne, James Edward, M.A., 8, Earlsfield-road, Wandsworth-common, S.W.
How, Thomas William, 1, Delahay-street, S.W.
Ive, Arthur Fenwick, 85, Montague-street, Worthing, Sussex.

Jennings, Sydney J., Messrs. H. Eckstein and Co., P.O. Box 149, Johannesburg, Transvaal, South Africa.
Kelynack, T. N., M.D., M.R.C.P., 53, Harley-street, W.
Kevorkian, Hagop, 3 Victoria-avenue, Bishopsgate-street, E.C.
Kilmer, Frederick B., Messrs. Johnson and Johnson, New Brunswick, New Jersey, U.S.A.
Kimber, Harry Watkins, Messrs. Dick, Kerr and Co., Limited, 110, Cannon-street, E.C.
Knowles, Hugh Charles, Glebe-house, Sherborne-lane, E.C.
Latif, Khan Bahadur Abdul, Bopatla, Kishna District, India.
Leeds, Edward Lambert, The Brown Hoisting Machinery Co., 39, Victoria-street, S.W.
Legg, Hugh G., P.O. Box 358, Cape Town, South Africa.
Le Roux, S. D., P.O. Box 100, Salisbury, Rhodesia, South Africa.
Letcher, John Teague, Truro, Cornwall.
Letcher, Thomas Henry, St. Day, Scorrier, Cornwall.
Lithgow, William T., Kingston Shipbuilding Yard Port Glasgow.
Littlewood, E. T., M.A., B.Sc., Wynberg High School for Boys, Wynberg, Cape Colony, South Africa.
Lonsdale, Earl of, Lowther Castle, Penrith.
Luke, James, 6, Pollock-street, Calcutta.
Lynch, Harry Finnis Bloss, 33, Pont-street, S.W.
Macbean, Edward, Rannochlea, St. Andrew's-drive, Pollokshields, Glasgow.
McConnell, John, Lanzi, Campiglia Marittima, Toscana, Italy.
Mace, Prof. William Harrison, A.M., Ph.D., 127, College-place, Syracuse, New York. U.S.A.
McGregor, John, Maitland, near Cape Town, South Africa.
Marsden, Alfred, A.M.I.Mech.E., Oakley Works, Windsor.
Mokhber-ed-Dowleh, His Excellency (Hossien Goli Khan), K.C.I.E., Teheran, Persia.
Morris, Philip A., Rose Bank, Harrow-view, Harrow.
Murphy, Sir James, Altadore, Blackrock, Dublin
Murray, James P., The Toronto Carpet Manufacturing Co., Limited, Toronto, Canada.
Murray-Morgan, Everard Home, A.I.Mech.E., Briar Lea, Prestatyn, N. Wales.
Naylor, John Alfred, A.M.I.Mech.E., 15, Cromford-road, West-hill, S.W.
Neville, Harry, J.P., Indwe, Cape Colony, South Africa.
Northcroft, G. A., Director of Public Works, Government Offices, Bloemfontein, Orange River Colony, South Africa.
Offen, Charles Rose Witcher, F.S.S., Home for Boys, Cumberland-road, Bristol.
Owtram, B., Chinese Eastern Railway Company, Mining Department, Yen-tai District, New chwang, China.
Paddock, George Harrie, Mill Bank, Wellington. Salop.
Pape, Eric, Farragut-building, Massachusetts-avenue, Boston, Massachussetts, U.S.A.
Parker, Sir Gilbert, D.C.L., M.P., 20, Carlton House-terrace, S.W.
Parkes, George W., The Frictionless Engine Packing Company, Limited, Hendham Vale Works, Harpurhey, Manchester.
Parnacott, Alfred Edmund, 12, Queen Adelaide-road, Penge, S.E.
Pearse, Cecil, Ipoh, Perak, Federated Malay States.
Pearson, Charles Fellows, Redington-lodge, Redington-road, Hampstead, N.W.
Peel, Hon. William Robert Wellesley, M.P., 52, Grosvenor-street, W.
Peregrino, F. Z. S., *The South African Spectator*, Cape Town, South Africa.
Pincus, Fritz, P.O. Box 3, Lourenço Marques, Portuguese South East Africa.
Pordage, Frederick, Entebbe, Uganda, viâ Mombasa, East Africa.
Quin, Stewart Blacker, 1, Lombard-street, Belfast,
Rana, Brigadier-Col. Kumar Nur Singh, Bahadur, Assoc.Inst.C.E., Superintending Engineer, Khatmandu. Nepal, India.
Rao, P. V. Ranganatha, B.A., B.L., Pudukotah, Native State, South India.
Reeve, Wybert, F.R.C.S., 1, Bishops-mansions, Fulham Palace-road, S.W.
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Seward, Frederick John, East London, South Africa.
Sheridan, René, Bangkok, Siam.
Shipway, Lieut.-Colonel R. W., V.D., Grove-house, Chiswick, W.
Shockley, William Hillman, care of Hongkong and Shanghai Banking Co., Limited, 31, Lombard-street, E.C.
Smith, Charles Horace, 25, Howard-street, Bradford.
Smythe, Francis, A.M.Inst.C.E., The Municipal Offices, Finchley, N.
Stead, Alfred, F.R.C.I., Clement's inn, W.C.
Steuart, T. B., Castlegilmour, Sanquhar, N.B.
Sutton, J. R., M.A., Kenilworth, Kimberley, South Africa.
Tays, Eugene Augustus Hoffman, M.Am.S.C.E., Fuerte, Sinaloa, Mexico.
Thomas, Arthur, M.Inst.M.M., Zalamea la Real, Huelva, Spain.
Thomson, A. S., Lodna, Jherria P.O., Bengal, India.
Tompson, Captain George Morris, M.Am.S.C.E., Parker-road, Wakefield, Massachusetts, U.S.A.
Turnbull, Alexander, M.D., 7, Lansdowne-crescent, Notting hill, W.

Wig, N. D., Messrs. Shivdev Singh Uberoi and Co., Punjab Iron Works, Sialkot City, India.

Wilkinson, William Thompson, 49, Casella-road, New Cross Gate, S.E.

Wilson, James H. Charnock, F.R.C.I., King's Leigh, Wembley, N.W.

Wood, Frank, Messrs. Foucar and Co., Limited, Rangoon, Burma.

Woodward, Harry Page, J.P., F.G.S., M.Inst.C.E., Moira Colliery, Collis Coal-field, Western Australia, and 129, Beaufort-street, Chelsea, S.W.

Wright, Richard Ernest, Assoc.M.Inst.C.E., Department of Public Works, Port Elizabeth, South Africa.

Yeoman, John Pattison, The Close, Brompton, near Northallerton, Yorkshire.

The paper read was—

SOME ASPECTS OF PHOTOGRAPHIC DEVELOPMENT.

By Alfred Watkins.

Development is the process of reducing those particles of silver salt which have been affected by light, to the black or metallic condition.

A finished negative consists of a contrast—or series of contrasts—between tones or densities. If the contrast obtained by reducing *all* the light-affected particles were always correct, the process of development would be simple and purely mechanical; for after devising a developer which did not attack the unaffected particles of silver salt, it would only be necessary to leave the exposed plate a sufficient time in the developer for it to do all its work, any longer time having no further action.

But practical photographers have long found out that with most plates and subjects a maximum amount of development, as above described, is injurious, and does not give the desired result, as the contrast between the tones is greater than represents the original object. A certain amount of judgment has therefore been necessary in deciding how far this reducing—or developing—action should be allowed to proceed. I must point out that this judgment or control has been—in the past—exercised in quite a different way from what I have indicated, and, as I shall try to point out, in a way the complications of which were quite unnecessary.

Instead of the photographer keeping the composition of his developer fixed, and controlling results by the time he allows it to act, he has been in the habit of keeping to his own time of development (varying, perhaps, only for temperature), and altering the composition of the developer to get greater or less contrast, or, to put it in another way, to get greater detail in one case, or greater density in another case. The photographer also has got into the habit of considering that he possesses the power (by altering the composition of developer) of doing more work either on the upper tones (adding density), or, in another case, on the lower tones (bringing up detail), whereas, in nine cases out of ten, he has merely attained a result identical with what he would have got with an unaltered developer acting for a certain time. This older point of view is partly a legacy from wet collodion development, where the presence of free silver nitrate in the developer actually built up the high light deposits in the negative, and partly arises from the use of an imperfect alkali (ammonia) in early dry-plate development. For the volatile nature of ammonia often made it necessary to add more of the alkali during the progress of development, and its tendency to fogging often made the addition of a restraining bromide necessary. These two procedures (adding more alkali to stimulate development, and adding bromide to restrain fog), both due to an imperfect alkali, have been continued when the use of a fixed alkali makes either of them unnecessary, and mysterious advantages have been attributed to them. In short, the development procedure of a few years ago resembled the medical knowledge of the 18th century, being built up of fads and formulæ, with no guiding principles to direct it.

It was the memorable paper of Messrs. Hurter and Driffield (*Journal Soc. Chem. Industry*, May, 1890) which pulled the complacent practical photographer up with a jerk, and showed that his ideas on development would have to be re-constructed. The writers impressed on a strip of plate a series of exposures increasing in geometrical ratio, thus:—1, 2, 4, 8, 16, &c., and investigated the effect of alterations in the developer. They found that the results of alterations consisted chiefly in variations of steepness of gradation (or contrast between the tones) attained, but that this was mainly a question of time, for all the developers (given sufficient bulk and activity) were capable of attaining the maximum steepness or amount of contrast if sufficient time to act were allowed. They named the degree of steepness or contrast the

development factor, but it was a weak point that the development factor was merely a record of a result attained, and not a help towards the attainment of the same result another time.

In the later paper by the same authors, published in the *Photographic Journal*, January, 1898, and following months, a most important light was thrown upon the action of a bromide as a restrainer, and the great differences between the results obtained by different experiments (especially as regards the speed of a plate) were traced to the peculiar action of a bromide in the developer.

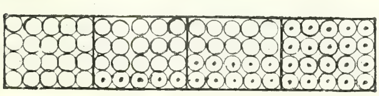
I shall not attempt, in this paper, to follow up the many proofs furnished by Messrs. Hurter and Driffield, but shall outline my own interpretation of the simple principles of development, using some illustrations borrowed from my recently-published manual on the subject, and shall pass on to some points arising from my own trials and investigations.

Simple Progress of Development.

I throw on the screen a strip of plate which has received an increasing series of exposures in steps, from $\frac{1}{10}$ sec. to 512 secs. Incidentally this also shows the limits of the plate, for it will be seen that 64 is the maximum effective exposure, anything more than this having no increased action on the plate, while $\frac{1}{10}$ is the minimum effective exposure, anything less than this having no action at all on the plate. The whole problem of exposure—which I am not expounding in this paper—is to bring all the light impressions which form the picture between these two limits. The upper strip is developed double the time, and the contrast between the tones is increased, for while the lowest tone has increased very little in opacity, the upper tones are greatly increased. Neither the maximum nor the minimum limits are altered by the longer development.

Fig. 1 is an imaginary section through an exposed film. Three exposures have been made on the plate, the part A being unexposed.

Fig. 1.

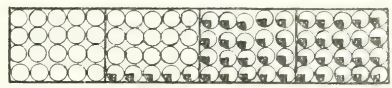


A B C D

The circles are supposed to represent the sensitive particles of silver salt, those dotted being affected by light, and capable of development, those undotted being unaffected. I need scarcely explain that in a graphic diagram like this, no attempt is made at completeness; for instance, in the part D all the particles are shown light-affected, whereas with long exposures in a thick film only about 60 per cent. of the particles would be light-affected.

In Fig. 2 an attempt is made to represent graphically what occurs when an efficient developer has one quarter accomplished its work,

Fig. 2.



there being a comparatively feeble darkening in all three tones with little contrast between them. Fig. 3 indicates the stage when development is half over; and Fig. 4 when development is completed, and all light-affected

Fig. 3.

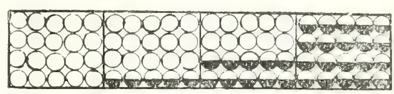
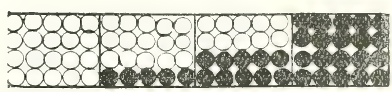


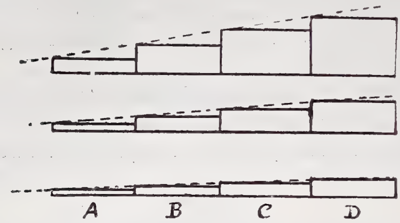
Fig. 4.



particles completely reduced to the black metallic state. With a well balanced developer there is no effect on those particles not affected by light, but an ill-balanced developer with excessive alkali will sometimes attack them, this being called fog. In these diagrams representing the simple course of development, it will be seen that the same *proportion of work* is done on each of the tones at each of the stages. But, as Messrs. Hurter and Driffield have pointed out, an arithmetical increase in the blackened silver results in a much greater (geometric) increase in its opacity or power of stopping light, and, therefore, in the natural course of development the contrast between the tones increases with the length of development. This rule applies with all developers, its limit being when fog commences and when all available light-affected silver is darkened in the darker tones.

Fig. 5 is an imaginary diagram of the silver representing the four tones compressed into steps, and at three stages of development.

FIG. 5.



The diagonal lines indicate what is conveniently termed the "steepness of gradation," and a register of this steepness is what Messrs. Hurter and Driffield term the development factor.

I make no attempt to discuss the question whether the reduction of the image is entirely a chemical or partly a physical process, and, in fact, I disclaim any qualification to throw light upon the chemical aspects of development.

CONTROL OF DEVELOPMENT BY TIME.

Although Messrs. Hurter and Driffield expounded the great importance of time in development, they gave no further help to uniformity in practice than the fact that, having once developed a plate to a required contrast or steepness of gradation, you could attain the same steepness (development factor) with another plate by using exactly the same developer, at exactly the same temperature, for exactly the same time. As it is difficult in practical work to ensure an exactly uniform developer (as regards alkali especially), and still more difficult to keep an exactly uniform temperature all the year, a practical working standard was still wanting. It is this aspect of development to which I have devoted most investigation.

In 1893, while testing a large number of plates for speed, and developing them together in one dish, I observed that some plates developed more readily than others, and attained contrast with greater rapidity; also that the image on these plates appeared more quickly than that on the others. In order to equalise the development, I adopted the plan of developing each plate for a fixed multiple of its time of appearance. In this particular case the time of appearance made correctly the allowance due probably to the different character of gelatines used in the emulsions. But this led to a long series of experiments, in which I established the fact that the time of appearance made the correct allowance for alterations in the activity in the developer, due to the following causes:—Temperature (between 45° and 75°); alkali in developer; dilution of developer—pyro and amidol being an exception to this.

The time of appearance is the time elapsing between pouring on the developer and the first appearance of any trace of the image. The multiple used to attain the required result I have termed the multiplying factor. The multiplying factor varies with different developing agents, such as hydroquinone, pyro, metol, &c.

The multiplying factor is usually the same for different commercial plates, but I have fonnd lately some plates which require a higher factor to secure sufficient contrast. These plates are some which makers seem to turn out in their efforts to secure a high speed reading. and I notice that they are a deeper yellow than usual. It seems, therefore, that an increased proportion of an iodide in the emulsion alters the multiplying factor. I have found, by the way, that a little iodide of potassium in the developer very much alters the law of appearance, the image appearing almost as quickly at the back of the plate as at the front. A bromide in the developer has quite an opposite effect. The use of a bromide or other restrainer in the developer alters the factor.

The experienced photographer using this timing system will sometimes alter the multiplying factor to bring an exceptionally wide range of tones in his subject within the limits of his printing process.

When investigating the laws of appearance, I found that the ratio of the appearances of all the various tones in an exposed plate was not altered by variations in the character and activity of the developer, and that if the times of appearance of a slip of plate exposed on the Hurter and Driffield plan, is plotted out in a similar way to the Hurter and Driffield method of plotting out densities, it is possible to read the speed of the plate by an observation of the diagram. I have made a recording instrument for observing these appearances, and recordiug them on a diagram, but do not propose to follow up this branch of the subject in this paper.

To return to the practical question of controlling results by time of development, I throw on the screen prints from negatives of the same subject and exposure developed in a 2 grain pyro soda developer, ½ grain bromide, for 3½

times to give a soft contrast, for 5 times to give a medium or correct contrast, and for 8 times to give an exaggerated or hard contrast. The advantage of this plan of timing development is that the same contrasts can be secured at another time even if the temperature is different and if the developer has not the same activity as regards alkali.

I do not propose to make this paper a complete practical exposition of this factorial method of development, for I have recently published a handbook on the subject; and I will pass on to examine those variations in the character or proportions of the developer which in the past have been relied upon to secure control of results.

It may be noticed that I have spoken of the main course of development quite independently of the developing agent used. This is because I find that all developers, after all the tones have appeared, and leaving fog out of the question, do the same proportion of work on the different tones and attain the same result if the right time is allowed to each.

Comparison of Developers.

But in comparing the different developing agents, some (such as hydroquinone and strong pyro) will be found to give density in the upper tones quickly and to bring out detail in the lower tones slowly. Another class of developers, as metol or rodinal, bring out all detail very early in the total stages of development, while density in the upper tones seems to follow slowly. I show on the screen three exposed slips each of three gradations, developed in rodinal, 1 grain pyro, and 8 grains pyro respectively, and each taken out the moment the lowest tone had appeared. The rodinal has only attained a very feeble density in the upper tone, the 8 grain pyro a considerable density, and the 1 grain pyro an intermediate amount. After this commencement, all three strips would pass through exactly the same stages of contrast. I should leave in rodinal for 40 times appearance, in 1 grain pyro (no bromide) 18 times, and in 8 grain pyro (no bromide), 6 times appearance, in order to attain the same final result, and these figures (40, 18 and 6) would be the multiplying factors for these developers.

I also show strips developed in metol and hydroquinone respectively, one strip of each being taken out of the developer at 1, 2, 3, 4, 5, and 6 minutes respectively. It will be seen that metol is very much ahead in stage of development at 1, 2, and 3 minutes, at 5 minutes hydroquinone has got level, and is identical in all the tones, while at 6 minutes it is the denser of the two in all the tones.

The different types of developers have, therefore, different ways of going to work; but I have never been able to discover that the final result differs if each is carried to the same stage of development, and no bromide is used. I show strips developed by five different developers to illustrate this, each carried to the same steepness of gradation. Even with hydroquinone, which brings out detail last of any, I find (provided no bromide is used) that the faintest detail rendered by the exposure is fully brought out when development is carried far enough for a suitable contrast for printing on P.O.P. A developer exceedingly strong in pyro seems to have slight restraining effect, and holds back the lower tones in the early stages.

I have explained at greater length the differences between developers in the *Photographic Journal*, April, 1900.

I must, however, note that my experiments have not included ferrous oxalate developer, which has the reputation of giving a lower speed. It has, however, practically gone out of use for negative work, and is being abandoned even for testing purposes. There are also some indications that a few exceptional plates are a little more sensitive to a particular developer, but this variation seems scarcely sufficient to have any bearing on practical work.

Influence of Bromide.

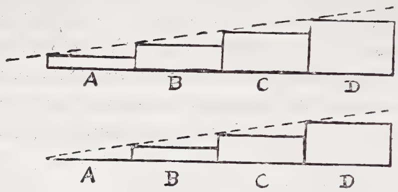
The restraining influence of a bromide in the developer has been explained by Hurter and Driffield in the *Photographic Journal*, July, 1898. They explain how its "holding back" influence on the lower tones is chiefly exercised in the early stages of development, and becomes less and less as development proceeds, until at an advanced stage of development the result with bromide is exactly the same in all gradations, as if the same plate were developed without bromide and carried to the same steepness of gradation. Even fog is only held back by bromide in the early stages of development. This explains many of the perplexing differences of experience—especially as regards speed of plates—which have occurred between different experimenters. I show on the screen a series of slips illustrating this point.

The "holding back" power of bromide has in practice by far the greatest effect with deve-

lopers of low multiplying factor, such as hydroquinone and strong pyro, for these have already a tendency to hold back detail until late in development, and the two combined "holding back" tendencies are sufficient to keep back the lower tones until a steepness of gradation quite sufficient for printing purposes is reached.

Fig 6 illustrates graphically the action of bromide in the developer, the upper illustration representing an imaginary section of the

FIG. 6.



densities of an exposed plate developed without bromide, and the lower illustration the same slip developed for the same time in the same developer with bromide added. It will be seen that the same steepness of gradation has been attained with both developers, but that the bromide has lessened the density in all the tones, and altogether prevented the lowest tone from appearing. With longer development, however, the lowest tone would come out, and the other tones increase in density to just the same extent as if no bromide were present. In these rough graphic diagrams, which are not intended to be exact, I have omitted the curves of under and over exposure.

The important part to remember is that this holding-back power is not exercised after the lowest tone has appeared; and it is therefore useless to add bromide some time after development has commenced. Most commercial plates of the present day develop sufficiently free from fog without the addition of a bromide, and I regard its use as quite unnecessary. Even in making lantern slides I have found that brilliant results can be secured without bromide in the developer.

WELL-BALANCED DEVELOPERS.

With each developing agent there is a strength which experience shows to have the most useful power without being in excess. This is usually from 2 to 4 grains to the ounce. There is also a proportion of alkali which gives sufficient energy without tendency to fog. This proportion with soda carbonate is about five or six times the weight of the developing agent. A developer thus proportioned is a well balanced one. Changes in the amount of alkali alter the speed at which development proceeds but have no other effect on the gradations, except that an excessive amount is apt to cause fog.

OLD METHODS OF CONTROL.

I continue to see, that at Photographic Society demonstrations, beginners are advised to "feel their way" in development, to begin with a small proportion of alkali, and add more in course of development. Not the smallest power is conferred by the proceeding, for the stages of development follow exactly the same course as if a standard solution were used from the commencement.

Let me also consider the procedure which the maker's instructions and the text-books have advocated for dealing with over and under exposure with pyro soda developers, when unknown beforehand.

It is usually advised that when the lower tones appear so slowly that under-exposure is feared, the developer should be diluted and more alkali added "to bring out detail." On the other hand, if all the tones come out in such rapid succession that over-exposure is revealed, the traditional advice is to add more pyro at once—say, 2 grains to the ounce—and an equal quantity of bromide, or else mix up and apply a new developer exceedingly strong in pyro and bromide. It is certain that such a developer has a great power of holding back the lower tones and altering gradation *when it is used from the commencement.* But I have never been able to discover that any such selective power exists when once these lower tones have appeared, or that the methods I indicate above, and which are usually termed tentative development, confer any power which cannot be equally well exercised by using a standard developer from the commencement.

The following are the details of a comparative trial which I show on the screen. A Paget XXXXX plate was exposed in a long series of gradations, and cut up into strips which were simultaneously developed in a two-grain pyro soda developer—no bromide, some in one dish, the remainder in another. The first tone appeared in 40 seconds, and as soon as all the tones were out (in 150 seconds) the following alterations were made, being previously got ready in measures. To the first set of strips (marked O for supposed over-exposure) two grains of pyro and two grains of bromide per ounce were added. To the second

set of strips (marked U for supposed under-exposure) double the previous amount of alkali, and an equal bulk of water was added.

The strips were taken out of each dish at intervals, and afterwards compared to see if the gradations had been altered by these proceedings. There was no evidence of control by any such alteration other than that given in both cases by length of development. I compare one O and one U strip, both having attained about equal contrast. All the tones are also equal, a little fog being added in the case of U.

Compensating for Varied Exposures.

It was Hurter and Driffield who proved that under and over exposures ought to receive the same time of development to secure the same contrast.

The strip of gradations on the screen, having alongside bits of over, medium, and under-exposed negatives all developed for the same time, illustrates this. The over-exposed negative utilises the upper tones of the series, and is denser throughout. The under-exposed negative utilises the lower tones of the series and is thin throughout; but, except where they fringe on the extreme tones which are under or over the range of the plate, both negatives give prints of much the same detail and steepness of gradation. In this time development, therefore, the exposure decides the density of the negative.

I have often developed six negatives in a dish together—snapshots, interiors, and landscapes mixed; observed the time of appearance of the average high lights of the series (ignoring especially over-exposed high light, such as a window in an interior), and developed for the fixed multiple of this time, knowing that a similar amount of contrast would be secured in all the negatives. No doubt the use of an actinometer (my own exposure meter) in gauging the exposures helped towards the uniformity of result; but a very considerable variation of exposure is allowable, the over-exposures in such a series being dense, and the under-exposures thin.

When I have had rollable films to develop, I have also followed the same plan of timing, developing the whole roll at once.

In fact, it is with rollable films that the method of developing different exposures for the same time has come into general use. Probably nine-tenths of the rollable films developed in the last year or two have been developed without cutting up the roll at all, perhaps in most cases on account of ease and simplicity, without knowledge that it was the theoretically correct proceeding. I mention this because I notice that several photographers in speaking of the results attained by roll film developing machines seem to think it is a new thing to attain uniformity of results by developing the whole roll at once.

If known beforehand over-exposure can be compensated for by using a short factor developer with bromide. Under-exposure if known beforehand can not be improved; the use of more alkali or of a long factor developer such as rodinal does not bring out any more detail than the ordinary formula (no bromide) gives. The only hope lies in heated development.

Summary of Principles.

Different developers vary in way of going to work, and speed of working, but not (bromide influence excepted) in final result.

Variation of the composition of a developer (bromide influence excepted) does not influence final result.

The bromide influence is not well under control, and cannot be exercised after all the tones have appeared. Bromide is best omitted from the developer, being unnecessary. The influence of time is quite sufficient for all control required.

The Two Time Methods.

There are two ways of deciding the time to develop, both depending on a previous trial. The first is my own factorial method in which the method makes correct allowance of most changes in the developer, for (usually) different kinds of plates or films and—most important—for variations in temperature; it also allows for using the developer a second time. The second is the Hurter and Driffield method—lately followed in film developing machines—of developing for a fixed time with a fixed developer. With this plan it must not be forgotten that the time is only right for that particular plate or film, and for exactly one composition of developer used for the first time, and for one temperature. The variation for temperature can, no doubt, be given in a table, but if it is ignored—as one demonstrator seems to have advised—summer results will be very different from winter results. A second use of the developer, or its dilution, also requires an increase in the standard time.

Mechanical Appliances.

In carrying out principles certain appliances are often helpful. With my factorial method, for instance, I devised a clock for the dark room with a ten minute dial and large minute divisions, as an ordinary watch, even a stop-watch, is not convenient. It is called the Eikronometer and has a calculator for giving the time to develop. It is a great convenience and its use has much increased lately. An ordinary metronome, or a half second chain pendulum, is a great help in counting seconds for the appearance of the image, either being better than a stop-watch. But I have always frankly explained that all the benefits of my factorial method can be obtained, although not so conveniently, with an ordinary watch. I, therefore, feel no hesitation in referring to a similar fact with regard to the two film-developing machines recently put on the market by two firms. They, no doubt, appeal to those who do not wish to use a dark room; but exactly the same results can be attained in a dark room by holding the whole roll of film in a U-shaped loop and see-sawing it, first through a bowl of water, and secondly through the developer in a basin for the standard time. These machines, of course, can only carry out the H and D time method, not my factorial plan. In developing films it is important not to stint the bulk of the developer. It is possible to use so small a quantity that its developing power is exhausted before the requisite work is done. In fact if negatives always contained the same proportions of high light and shadow it would be quite possible to control the steepness of gradation by limiting the total amount of developing salt.

DISCUSSION.

Mr. Chapman Jones said he had learnt much from the paper, although a great part of it travelled over old ground. But when Mr. Watkins made a diagrammatic representation of what had taken place in development, he often failed to represent fairly what he had demonstrated by his experiments. One of the first diagrams indicated the course of development, and showed how a certain number of particles, after exposure by light were, during development, reduced in a certain proportion, and by further development in a further proportion. Mr. Watkins, however, showed that under many conditions of development the particles were not all acted upon simultaneously, but that there was a considerable amount of action in the high lights before there was any change in the shadows. The diagrams tended to show what he thought Mr. Watkins would like to show rather than the fact which he demonstrated in the actual experiments. With regard to the control obtained by the use of bromide and by altering the concentration of the developer, he thought a good deal of control could be obtained; and, indeed, Mr. Watkins's experiments seemed to demonstrate this. The tendency of many people in the past appeared to have been to imagine that a good deal more control was obtained than was the case; but the tendency now he thought was in the opposite direction, people denying that one had control at all. The latter fact, however, was amply proved by Mr. Watkins, who had explained in a fair way that one could get over the difficulty of over-exposure, if one only knew the fact beforehand, by the introduction of bromide. But it was said that bromide was of little use unless put in at first. That seemed to him, (Mr. C. Jones) a statement which was very difficult to prove. If one started development and washed off the developer before it went too far, then it was possible to substitute a slow acting developer. At any rate, it was difficult to prove that it was not possible. With regard to developing a long series of negatives for the same time and getting useful results, that had been argued a good deal lately, and he thought the two extremists were both wrong. Under certain circumstances, if one developed negatives having various exposures for the same time there would be obtained many spoilt negatives; but if negatives all tended to under-exposure, which was the usual case in kodaks and such like cameras, it was impossible in many cases to over-develop. There was no further change unless the film remained so long that there was fogging, and the fogging could be easily distinguished from the developing stage. He understood Mr. Watkins to say that one could deal with over-exposure but not with under-exposure. He thought that quite wrong, as Mr. Watkins himself appeared to have shown. Of course that which was not on a plate could not be developed from it, but in many plates there was a tendency to get a great density in the high lights before the detail and shadows had appeared, but by using a judicious developer, which brought out the details first, a harmonious range of gradations could be obtained, and the operator could stop at any stage he wished.

Mr. J. H. Gear said he did not hold with hard and fast time development, but whenever he had adopted time development he had always succeeded with his plates. A very considerable advantage in the timing of development was found when dealing with tricolour work. He did not know how it was possible to develop three negatives with equal opacity where there was a different range of gradations, so to speak, caused by the various colours, and he felt that the timing method under such circum-

stances was the only reliable system in order to get the three colours at their correct opacity. With regard to the alteration in the factorial time, he had found plates of the same manufacture vary somewhat, for instance, Lumiere's A. plates, and their B. plates, and the plate sensitive to red. Taking the factor of 4 for the A. plate and also for the red plate, that did not give the same opacity as the green plate; and in order to develop those plates with the factor, he had found it absolutely necessary to take 4 for the blue plate, 4 for the red plate, while $3\frac{1}{2}$ gave the same opacity for the green plate. He thought it must be admitted that there was not the control in development which had been previously imagined, if one adhered to the pyro and soda developer. He had no doubt that bromide had but little effect after once commencing development, and he would not expect to get the control in the development by the addition of bromide. but by the addition of sodium citrate. He felt the sodium citrate was practically the only control they possessed. When the plate was over-exposed, the results were as Mr. Watkins had shown.

Rev. F. C. LAMBERT said he felt the following difficulty. If he had a slow plate giving a considerable range of exposure, was he to understand that one had to take the time from the pouring on of the developer to its first appearance, and multiply that for a constant factor under all conditions? Suppose the image appeared in ten seconds, and the factor was six, he must develop for one minute; if with that plate he gave the shortest possible exposure, and gave the other half of the plate the longest possible exposure, he would expect under those conditions that the time of the appearance of the image would be different; the more brief the exposure the slower would be the picture in appearing; but if he used the same factor in both cases, would he get the same result? He anticipated an opposite result, because he imagined that for the same degree of contrast, the longer exposure, which came out first, should have the higher multiplying factor.

Mr. W. THOMAS, speaking as an ordinary practical photographer, said that what one wanted, as a rule, was the maximum result from light action in the shadows, and a very considerable stage of that maximum result of light action in higher stages. He thought highly of the work done by Mr. Watkins, and while agreeing with almost everything he had laid down, he could not bring himself to find that his own practice was in accordance with those doctrines. Taking a subject with white and as near dark as could be got, some parts lit with clear brilliant sunlight and the others in the shade, there was something to deal with beyond those; there was such a thing as light and shade, and such a thing as colour. Colour entered into such matters in a very important way, and he thought it was not taken sufficient note of in escriptions and lectures on the subject. It seemed strange to say that the results produced could not be altered and varied, and he said so with the more confidence after what he had heard that evening. He thought if there was lacking proof that control was possible and existed, that proof had been furnished by Mr. Watkins himself. With regard to the addition of bromide after the development had commenced, he understood the reader of the paper to say the result of his work had been to convince him that no saving alteration could be brought about by the addition of bromide once development had commenced. Such an experience was opposed to his own.

Mr. FRIESE GREENE agreed that the bromide in the developer had only a kind of mechanical, and not a chemical action, but he wanted to bring before the meeting the fact that if the continuous electric current were introduced at the beginning of the development where bromide was used it seemed to enhance the retarding action of the bromide.

The CHAIRMAN said Mr. Chapman Jones had dealt with much that he had intended touching upon. Everyone must admire the great care with which Mr. Watkins had conducted and recorded his experiments on development, and that gentleman had cast a new light on many manipulations in that process. Mr. Watkins had shown that there was a factor, which, if used, would enable the photographer always to arrive at the same degree or intensity of gradation. Of course there was a certain difficulty in arriving at a factor. For instance, what was the first appearance? That was to a large extent a question of a personal equation, and with that he fully agreed. One person would see a black speck coming out on a negative before another person. He had often developed side by side with his assistants and friends, and it had often been difficult to decide at what exact time the image appeared. But that could be got over, and when once the personal equation had been arrived at, one could have a factor for different kinds of plates for development. He had made a great many experiments, and he had come to the conclusion that there was a great deal more control in developing a negative than Mr. Watkins liked to allow. He was not a professional photographer, and therefore he did not develop the plates because he was obliged to, but he looked upon the development of every plate as a kind of experiment; and if anything remarkable occurred during the process he repeated it to see what it meant. At the time of Hurter and Driffield's paper, there was a great controversy as to whether there could be an alteration brought about by variation of the developer. He had neither the time nor the inclination to enter into that controversy; he had a controversy on another point with those same gentlemen, but the experiments he had carried out left him no doubt, that there was a control in development by means of varying the developer. On the screen was represented development by means of metol, and one by ortol. If one exposed two strips, as he had himself

done, in the way Mr. Watkins had, one could leave the metol strip in for half a day without getting the same intensity or gradation as with the ortol. That was a matter of experiment, and without fog appearing in either. From the strips on the screen he would have expected to find that gradation would be the same in both cases. Perhaps Mr. Watkins would explain why that was not always the case; as it was not. With regard to the question of the dilution of the developer, looking at the matter from a chemical standpoint, he thought it would be seen that chemical action was always considerably altered in effect by dilution, and, whatever happened in ordinary chemical operations, one would expect to happen also in the chemical operation of development. He did not propose to enter into arguments, nor to give a history of any experiments there might be, but he might say generally that Mr. Watkins was right in his conclusions, but although generally he must allow a little more scope for those who held contrary views. He could quite support the remark made by Mr. Gear as to sodium citrate, and, moreover, the addition of citric acid was a well-known way by which one could retard the action of an over-exposed plate. He believed Mr. Warnerke was very strong on the different materials with which an over-exposed plate could be saved, even after the developer had been on. Mr. Watkins had almost convinced him that there was not much use in putting a large quantity of bromide on during development; but if the developer were washed off before the action had got very far, and if the development were restrained by means of a very dilute solution of hydrochloric acid, there was obtained a decent negative from a very much over-exposed plate. A remark had been made about developers and single solutions. A friend of his used to employ those one-man solutions, and to buy them in cartridges. He came to him (Sir W. Abney) in trouble one day, though he had used half a cartridge; but it appeared that he had used the top half and left the bottom half behind.

Mr. WATKINS in reply, reminded his hearers that he had not attempted to traverse the whole ground, and that his paper was entitled, "Some Aspects of Photographic Development." He had not asserted that no control existed. He would not wish to argue with Sir William Abney the points raised by that gentleman, because of his large experience. He admitted that the question of colour was a very important one, and that it had to be provided for and allowed for, but that must be done in exposure, not in development. He had not been able, in experiments, to find that any control existed by adding bromide after the tones had appeared. He had not experimented with sodium citrate, the substance mentioned by Mr. Gear. Mr. Lambert's question touched a weak point. The high light of an under-exposure appeared in slightly different time to the high light of an over-exposure, and this introduced a small error into the factorial method of development. It was, however, a very much smaller error than the advantages obtained by compensating for temperature and the amount of alkali. The difference in the high light was very little in under-exposure compared with over-exposure. Generally those who followed the timing development used an actinometer for getting the exposures. In practice he did not find it a difficult matter. His experience was that in an under-exposed snapshot one must cut the development short.

On the motion of the CHAIRMAN, a hearty vote of thanks was passed to Mr. Watkins, and duly acknowledged by him, and the proceedings terminated.

A collection of developers and developing apparatus was exhibited by the following manufacturers:—

Bayer and Co.—Developers in liquid powder and cartridge form.

Burroughs, Wellcome and Co.—Developers in tabloid form.

Fuerst, Bros.—Developers and other photographic chemicals in powder and cartridge form.

Griffin and Sons.—"M. Q." devoloper in cartridge and other forms.

Hinton and Co.—"Hintokinone" developer and rocking apparatus.

Houghton and Son.—"Wyndham and Volvo" film developing apparatus.

Kodak Limited.—Daylight developing machines for films, and developer cartridges.

J. E. Lockyer.—Concentrated liquid developers.

E. Merck.—Developers in powder and cartridge form.

Paul Metz.—"Brilliant" concentrated one solution liquid developer.

Penrose and Co.—Safe night filter and lantern for developing room.

Sanger, Shepherd and Co.—Latest pattern of Hurter and Driffield speed determinator apparatus, photographic developers, &c.

Watkins Meter Co.—"Eikronometer" and exposure meters.

Miscellaneous.

THE ST. LOUIS EXHIBITION.

A correspondent sends to the *Times* the following account of the progress of the St. Louis Exhibition:—

The preparations for the Universal Exhibition, which is to be opened at St. Louis, on May 1st, 1904, are going steadily forward. It is generally known that it will commemorate the centenary of the acquisition of the million square miles included in the Louisiana purchase, and now divided into 12 States and territories, with a population of nearly 15 millions.

The Government of the United States has appropriated 6,308,000 dols., the City of St. Louis 5,000,000 dols., and the Exposition Company, which manages the undertaking, has raised 5,000,000 dols. more. About 25 States have signified their acceptance, and have arranged for special exhibits of their history and resources. These are headed by the State of Missouri, in which the Exhibition is to be held, with a grant of 1,000,000 dols. The remaining States, very likely without exception, will appropriate money at the sessions of their Legislatures during the coming winter.

Building operations are well under way, and it is the intention of the management that the five principal buildings shall be ready nearly a year before the opening of the gates. Every effort will be made to have each department and building actually ready with its exhibits by May 1st, 1904. The floor space of all the buildings for the Exposition proper, and of those erected by the various States, will cover an area of about 200 acres. As most of the structures will be single-storied, these, of themselves, will occupy about one-sixth of the 1,200 acres in the site. In addition, there will be the buildings erected by foreign Governments and by the various societies, and those for the amusement concessions.

Negotiations to obtain the co-operation of foreign countries are going on with all due haste. Those, large and small, which have already accepted, number about 25, and include Great Britain, France, Germany, Italy, Turkey, Japan, China, Korea, Brazil, the Argentine Republic and some of the other principal countries of South America, Mexico, and one or two of the leading countries of Central America. To this list must also be added Canada which has set aside 125,000 dols. as a preliminary grant, which, it is thought, will be doubled before the Exhibition opens.

France, as the first country to accept the invitation, mainly by reason of its close relations to the cession of Louisiana in 1803, has made a preliminary appropriation of 650,000 francs. It is believed that this will be doubled or trebled during the next year. The German Commissioner is now in St. Louis for the purpose of choosing a site for the building to be erected by that Government. Both Germany and France have pledged themselves to make larger and finer exhibits than at any previous exhibition, other than those held in Paris. Italy will make a distinctive art exhibit, Japan has made an initial grant of 800,000 yen (about £80,000), while Korea and China will be more completely represented than upon any previous occasion. The same is true of Mexico and Canada. It is expected that many of the remaining countries will announce their decision within the next three months. The British Government will be asked to enlarge the scope of its acceptance, which is limited thus far to the assurance that complete exhibits will be made in art and education, and facilities afforded to industries.

The expenditures at international exhibitions, like that to be held at St. Louis, are best illustrated by those at Chicago. For the principal Governments, they were on that occasion as follows:—Brazil, £120,000; Costa Rica, £30,000; Ecuador, £25,000; France, £143,000; Germany, £170,000; Great Britain, £60,000; Japan, £126,000; Holland, £20,000; Paraguay, £20,000; Spain, £43,000; and Sweden, £22,000. While the detailed reports are not available, as a whole the countries named incurred approximately the same expense at the Paris Exhibition of 1900.*

The following Table illustrates the extent to which Great Britain has participated in former international exhibitions, and gives the amount expended on each since 1867, and also, in square feet, the space occupied. The latter part of the Table, in all cases, includes the colonies, while, with regard to that dealing with expenses, it should be mentioned that it has recently been customary for the colonies to defray their own:—

	Paris, 1867.	Philadelphia. 1876.	Paris. 1878.	Paris. 1889.	Chicago. 1893.	Pasis. 1900.
Amount expended	£ 125,592	£ 39,981	£ 66,983	£ 29,422	£ 60,000	£ 125,000
Space occupied	280,604	194,381	363,018	232,845	517,161	294,612

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock:—

DECEMBER 10.—"French Rural Education and its Lessons for England." By CLOUDESLEY BRERETON. LORD REAY, G.C.S.I., G.C.I.E., Chairman of the London School Board, will preside.

DECEMBER 17.—"The South Russian Iron Industry." By ARCHIBALD P. HEAD, Mem.Inst.C.E. MR. WILLIAM EGERTON HUBBARD will preside.

INDIAN SECTION.

Thursday afternoon, at 4.30 o'clock:—

DECEMBER 11.—"Domestic Life in Persia." By MISS ELLA C. SYKES. EARL PERCY, M.P., Under Secretary of State for India, will preside.

Papers for Meetings after Christmas:—

"Industrial Trusts." By PROF. W. SMART, LL.D. SIR ROBERT GIFFEN, K.C.B., LL.D., F.R.S., will preside.

"Oil Lighting by Incandescence." By ARTHUR KITSON.

* The cost of the British Section at Paris, 1900, was more than double the cost at Chicago. The figures are given in the Table at the end of the article.—ED. *Society of Arts Journal.*

"The Metric System." By A. SONNENSCHEIN.

"The Cost of Municipal Trading." By DIXON H. DAVIES.

"Stage Costumes and Accessories." By PERCY MACQUOID.

"The Principles of Applied Art." By G. F. BODLEY, R.A.

"Modern Movements in Decorative Art." By CHARLES HOLME.

"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo.

"Three Colour Printing." By HARVEY DALZIEL.

"The Port of London." By Dr. B. W. GINSBURG.

"Tonkin, Yunnan and Burma." By FRED. W. CAREY, late H.B.M.'s Acting-Consul at Szemao, China.

"The Indian Census." By JERVOISE A. BAINES, C.S.I.

"The Province of Sind." By HERBERT M. BIRDWOOD, C.S.I., LL.D.

"Women in Canada." By the COUNTESS of ABERDEEN.

"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., C.I.E.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

PROF. VIVIAN B. LEWES, "The Future of Coal Gas and Allied Illuminants." Four Lectures.

LECTURE III.—DECEMBER 8.—The relation of the candle-power and calorific value of gas to its use with the incandescent mantle—The incandescent mantle and the directions in which it will be improved—The probable future of coal gas.

LECTURE IV.—DECEMBER 15.—Lighting by oil and the advances of the past fifty years—The use of oil in incandescent mantle lighting—Vapour burners and their future—Air gas and its latest developments—The present position and future of acetylene.

JUVENILE LECTURES.

Wednesday afternoons, at Five o'clock:—

Professor EDWARD B. POULTON, M.A., D.Sc., F.R.S., "Means of Defence in the Struggle for Life among Animals."

Lecture I., December 31. Lecture II., January 7.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 8...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. Vivian B. Lewes, "The Future of Coal Gas and Allied Illuminants." (Lecture III.)

Farmers' Club, Salisbury-square Hotel, Fleet-street, E.C., 6 p.m. 1. Annual General Meeting. 2. Mr. A. D. Hall, "Soil Analysis and Soil Maps: What Information can they give the Farmer?"

Surveyors, 12, Great George-street, S.W., 4 p.m. Mr. James W. Tyler, "Estate Duty Valuations and Agricultural Property."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Dr. Sven Hedin, "Three Years' Exploring Work in Central Asia."

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Sir Wyke Baylis, "The Bogey in the Studio: an address to lovers of art on vexed questions of the day."

TUESDAY, DEC. 9...Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. T. H. Minshall's paper, "High Speed Electrical Generating Plant."

Photographic, 66, Russell-square, W.C., 8 p.m. Dr. R. Norris Wolfenden, "Photography in Marine Zoology."

Anthropological, 3, Hanover-square, W., 8 p.m.

Colonial Institute, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Mr. Hugh Clifford, "British and Siamese Malaga."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

Asiatic, 22, Albemarle-street, W. 3 p.m.

WEDNESDAY, DEC. 10...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Cloudesley Brereton, "French Rural Education and its Lessons for England."

Sanitary Institute, 74a, Margaret-street, W., 8 p.m. Dr. Louis Parkes and Messrs. J. Osborne Smith, and W. C. Tyndale, "Drain Testing."

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS, 11 a.m.

Biblical Archæology, 37, Great Russell-street W.C., 4½ p.m.

Japan Society, 20, Hanover-square, S.W., 8½ p.m. Mr. St. John Dixon, "Some Japanese Artists of To-Day."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Mr. F. T. Jane, "A Scheme for the Absolute Protection of Commerce in the next Naval War."

THURSDAY, DEC. 11...SOCIETY OF ARTS, John street, Adelphi, W.C., 4½ p.m. (Indian Section.) Miss Ella C. Sykes, "Domestic Life in Persia."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Traill Taylor Memorial Lecture, Prof. H. H. Turner, "The Great Photographic Star Map."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Josiah Booth, "Tone Painting in Song."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Dr. J. A. Fleming, "The Photometry of Electric Lamps."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. Sanger Shepherd, "Colour Photography on Paper."

FRIDAY, DEC. 12...North-East Coast Institute of Engineers and Shipbuilders, Sunderland, 7½ p.m. Mr. J. Hamilton Gibson, "Large Stop Valves for High Pressure Steam."

Astronomical, Burlington-house, 5 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

SATURDAY, DEC. 13...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, December 15, 8 p.m. (Cantor Lecture.) Professor Vivian B. Lewes, "The Future of Coal Gas and Allied Illuminants." (Lecture IV.)

Wednesday, December 17, 8 p.m. (Ordinary Meeting.) Archibald P. Head, M.Inst.C.E., "The South Russian Iron Industry."

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, December 31st and January 7th, at 5 o'clock, by Professor Edward B. Poulton, M.A., D.Sc., F.R.S. (Hope Professor of Zoology in the University of Oxford), on the "Means of Defence in the Struggle for Life among Animals."

Special tickets are required for these lectures, which can be obtained on application to the Secretary. A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions, each member is entitled to a ticket admitting two children and an adult. The cards are now in course of issue.

CANTOR LECTURES.

Professor Vivian B. Lewes delivered the third lecture of his course on "The Future of Coal Gas and Allied Illuminants," on Monday evening, 8th inst.

The lectures will be printed in the *Journal* during the Christmas recess.

CANTOR LECTURES ON "GLASS FOR OPTICAL INSTRUMENTS."

Dr. Richard T. Glazebrook's Cantor Lectures on "Glass for Optical Instruments" have been reprinted from the *Journal*, and the pamphlet (price One Shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C. A full list of the Cantor Lectures which have been published separately and are still on sale can be obtained on application to the Secretary.

Proceedings of the Society.

FOURTH ORDINARY MEETING.

Wednesday, December 10, 1902; Sir Philip Magnus in the chair.

The following candidates were proposed for election as members of the Society:—

Acland, Miss Sarah Angelina, Cleveden-house, Park-town, Oxford.

Dallin, Cyrus Edwin, 89, Oakland-avenue, Arlington Heights, Massachusetts, U.S.A.

Dangerfield, James, Artillery-mansions, Westminster, S.W.

Dunham, Andrew Allen, care of Casein Company of America, 11, Broadway, New York, U.S.A.

Dunnicliff, H. B., 5, Kestrel-avenue, Herne-hill, S.E.

Gibson, James Glen S., F.R.I.B.A., 27A, Old Bond-street, W.

Giddons, John Harcourt, Austral, near Liverpool, New South Wales, Australia.

Hopkins, John Guthrie, Alberene, Albermarle County, Virginia, U.S.A.

Judd, Walter, 5, Queen Victoria-street, E.C.

Kinealy, John Henry, 1108, Pemberton-building, Boston, Massachusetts, U.S.A.

Livesey, David Thomas, Luxville, London-road, East Grinstead.

McCormack, Joseph Nathaniel, M.D., LL.D., Bowling-green, Kentucky, U.S.A.

McLusky, William B., City of Perth Gas Department, Perth, N.B.

Scantlebury, Captain Vincent John, Assoc.Inst.N.A., 21, St. Petersburgh-place, Bayswater, W.

Scott, Percy Gilbert, 34-37, Dobson's-road, Howrah, India.

Silberrad, Dr. Oswald, Hill-top, Shooter's-hill, Kent.

Spencer, Frank Barnes, Ovenden, Kingswood-road, Wimbledon, S.W.

Wall, J. W. Russell, Raglan Villa, Holly-park, New Southgate, N.

West, George F. Myddleton, J.P., 35A, Great Cumberland-place, W.

West, Mrs. George Cornwallis, 35A, Great Cumberland-place, W.

Woollan, Miss Helen A., 28, Brook-street, Grosvenor-square, W.

The following candidates were balloted for and duly elected members of the Society:—

Aitken, Thomas, Assoc.M.Inst.C.E., Surveyor's Office, County-buildings, Cupar, Fife, Scotland.

Baker, George Samuel, "Frontenac," Donnington-, road, Willesden, N.W.

Barber, René R., Messrs. William Barber and Bros., Georgetown, Ontario, Canada.

Cole, Charles Henry, Assoc.M.Inst.C.E., H.M. Dockyard, Malta.

Connett, Albert Newmann, M.Am.Soc.C.E., Tyndale-lodge, Bromley, Kent.

Eborall, Alfred Cecil, M.I.E.E., 115, Tulse-hill, S.W.

Foot, Herbert, B.A., F.I.A., 13, Marlborough-place, St. John's-wood, N.W.

Hardcastle, Edward, Rose cottage, New-road side, Horsforth, near Leeds.

Hardy, William Eversley, St. Oswald, Alexandra-road, Norwood.

Northcott, James, 12, Herne-hill, S.E.

Pearson, Captain James Bruce, care of Managing Agents, British India Steam Navigation Co., Ltd., Calcutta.

Simpson, Percy, "Ocean Wave," St. Ives, Cornwall.

The paper read was—

FRENCH RURAL EDUCATION.

By Cloudesley Brereton.

In order to understand the problems of the French rural school, it would seem essentially necessary to look at them from the French point of view, especially if we are to appreciate the value of the solutions adopted. Now, to the French mind, a part of any system only finds it full and complete explanation in its relation to the whole. It is in harmony with this theory that the whole educational organisation of the country has been built up. Even when a new subject has been introduced into the time-table of the primary school so apparently unconnected with the rest as the *enseignement agricole* (agricultural instruction), it has never been allowed to remain long in its isolation, but has been speedily woven into the fabric of the school curriculum. Or, to use another figure, if each new subject represents a new force, all the subjects are so converged that though the direction of the resultant or aim may be altered, the aim itself remains unimpaired. Hence, to limit one's survey of rural education to what passes within the four walls of the village school, would seem to be as instructive as to present one's audience with an elephant's tooth, and leave them to imagine the jaw that supplied it with driving power, not to mention the animal itself and its habits which have evolved it into its present condition. French primary education, in fact, is so highly centralised, so much of the energy manifest in the schools appears to come from the central power station, that it seems needful for anyone who wishes to comprehend any large section of it, to obtain a bird's-eye view of the whole machinery.

Yet at the outset a word of warning is requisite. This centralisation, however uniform it may appear in Blue-books and Government publications, depends for its administration on the character of the *personnel* who run the machine—the officials, the inspectors, and the teachers, and how these naturally differ in energy, views, and aims need not be dilated on here. The mere fact of whether stress is laid on one part of the programme or another is bound to produce a certain decentralisation that itself is aided by the nature of the programme, which is not so inelastic as is popularly supposed. Another element of differentiation is introduced by the racial differences between the inhabitants in the various departments. Education in the Nord, with its affinities with Belgium, and education in Alpes Maritimes, with its strong Italian proclivities, are evidently working on very different materials. One must, therefore, not only enter a caveat against one's audience taking too uniform a view of French education, but one must also be careful oneself to guard against making too sweeping generalisations.

The territorial character of the population, to which allusion has just been made, is, however, not merely an element in promoting decentralisation, it is also an item to be taken into account when appraising the success or failure of the rural school. Who speaks of character, speaks of home, the religious influence, the social *milieu*—three powerful factors that can do much to help or hinder the school's endeavours. The two first-named

forces reveal themselves in such questions as—Is the school popular with the parents? and how does it shelve, solve, or sever the religious difficulty? As for the influences that the social *milieu* exerts, their name is legion, for their area of recruitment is world-wide. Everywhere the centripetal force of the towns is growing. Which way, we ask, is the rural school pulling? Then comes a whole plexus of problems. Is there a rural exodus, and, if so, are the causes higher wages in the towns, conscription, the laws of inheritance, or alcoholism? So that the last question we have to ask is this: In the midst of the general rural decay is the school a centre and a rallying point of all social reform, or is it merely content to interpret its duties in the narrow sense of instruction pure and simple?

The problem is a big one, but it has got to be faced if it is to be properly stated. After all it is surely better to state factors imperfectly and superficially than conveniently to ignore them and set the school thereby in a false perspective. The aim of the present paper therefore will be twofold: after a rapid sketch of the general machinery as far as it has reference to the rural school, to present as complete a view as time permits of the rural school itself, and, secondly, to give a rough idea of the conditions prevailing in those parts of rural France with which the speaker is personally acquainted, in order to indicate the problems to which the rural school can even under the most favourable circumstances offer only a partial solution. *En passant* one hopes to bring out such points in French methods as seem worthy of imitation. But the two systems, French and English, are so different, there is nothing we can copy wholesale except it be the spirit of thoroughness which has animated French reformers.

To understand the present highly developed condition of French primary education, a rapid sketch of its past history seems necessary. The only name that needs be cited before the Revolution is that of Jean Baptiste de la Salle, the founder of the Christian Brothers—who in any history of the early beginnings of popular education must find a foremost place. Thanks to his teachings the monitorial system never took abiding root in France, being soon ousted by the so-called simultaneous methods of his followers. The Revolution did little else than express a pious resolution in favour of a complete system of free, popular, and compulsory education. The three great names after the Revolution are Guizot, Duruy, and Jules Ferry. Guizot, who must be looked on as the founder of the system, began his reforms by a survey of the educational plant on the ground, a proceeding that might well be copied, especially as regards secondary education, by those who will have to carry out the provisions of the present Bill before Parliament. Compulsory education was not established by him, but each commune had to build a school and pay the teacher. He started also the building of girls' schools, and normal schools, and the creation of an inspectorate. The *Loi Falloux*, in 1850, divided primary schools into State and private schools, and recognised both. The *régime* of Duruy is remarkable for the great extension given to evening classes, and to the founding of girls' schools as well as the establishment of the *caisses des écoles* for helping the children of the poor who frequent the schools.

The Third Republic began setting its educational house in order by a vast building and furnishing scheme. Every commune was obliged to provide itself with, or share in a State school; every department was compelled to possess a couple of normal schools. State aid was freely given, and in all, £34,000,000 were spent by central and local authorities, 35,145 schools were built or acquired, the total of normal schools was brought up to 163, and two higher normal schools for providing these schools with teachers were founded. Having put the buildings on a sound footing, the teaching profession was next raised to the level of a skilled calling by compelling all teachers in religious or lay schools to hold a *certificat de capacité* (or attainments' certificate), while the State teachers were further obliged to possess a certificate of training (*certificat d'aptitude pédagogique*).

Then came the triple reform of free, compulsory, and secularised education, with which the name of Jules Ferry will ever be connected. The latter cut the painter once for all between the public and private school, between the State and the different cults. The teaching of *la morale* was substituted for denominational teaching, and in the State schools the religious teachers were either immediately or gradually replaced by laymen. The religious schools were left entirely free, the State only exercising a certain supervision over the sanitation and text-books and professional status of the teachers. The result is that in 1897, the total number of children still under religious instruction was 1,603,451, of whom 405,825 were still in State schools not yet laicised,

against 3,823,760 in the lay schools. This does not include the maternal schools. If these are reckoned in the figures are 1,955,199, against 4,175,656. The great majority of the pupils over 6 in the religious schools are girls; there are in all only 436,726 boys in these schools. Of the Association laws it is impossible to speak here, as it is at present doubtful as to what their precise effect on primary education will be.

These reforms necessitated certain financial readjustments, the most important of which was the transference of the payment of the teacher from the locality to the State. In thus abolishing the payment of salaries by localities the Republic seems to have solved a large number of grievances. Henceforth the teachers were grouped in classes in which promotion depends on merit and seniority. It is probable that our County Councils will, sooner or later, have to formulate a similar scheme. Now that the *raison d'être* of inequalities in salaries has gone, the inequalities will have to go. The Republic has also to its credit the re-establishment of the higher primary schools, which have been an immense benefit to town and country; and lastly, the most recent improvement is the revival and enormous extension of evening classes. This has been largely a teacher's movement, and is an admirable instance of the striking enthusiasm and devotion that pervades their ranks. One might almost call them the knights templar of republican defence and popular education. The beneficial effect of these drastic and thorough-going reforms on rural education is obvious, if we put on one side the vexed religious question. The country school buildings are not allowed to fall below a certain minimum of requirements. Salaries not being a matter of locality, the tiniest hamlet may, and often does, possess one of the best teachers of the department.

And now to come to the actual machinery. We find the Minister has cognizance of all schools as far as the sanitation and staffing are concerned. There is in fact no free trade in teaching, nor can a school label itself with any high sounding title it pleases; all schools, public or private, must have the Government hall-mark. The fraudulent private school is an impossibility in France. Yet this does not mean that the neutral private school is disliked. On the contrary, the most thoughtful of French reformers are highly anxious to encourage private initiative in this direction—a matter our new authorities may well lay to heart.

The Ministry itself is divided up into three sections—University, Secondary, and Primary. The latter has the joint supervision of a few quasi-technical schools, but technology proper and commercial education are under the Ministry of Commerce. Agricultural schools are under the Ministry of Agricnlture. Attached to the Ministry is a consultative committee; six of its 57 members are elected by primary officials and teachers. The primary section of the Ministry keeps itself in touch with the actual state of education by means of eleven general inspectors. They act not only as the eyes and ears of the central authority, but also as its mouthpiece, Thus a year or two back it was decided to re-organise agricultural education, and one of the inspectors made a tour of all the training colleges in order to give the right trend and direction to the teaching of the subject.

Coming to the local authorities, the rector of the local university looks after the normal colleges in his district as well as the education side of the primary schools. In fact, one may look on him as a sort of lay bishop whose seminaries are the normal colleges, and who supervises the articles of faith and religion represented by the education taught in the primary schools. But his second in command, the academy inspector, being the man on the spot (there is one for each department) possesses really more effective power. In administrative matters, and in the selection of the *personnel* he is independent. While directly appointing the probationers, he also nominates the full teachers, while the Prefect appoints them. Situated midway between the central authority and the schools, yet near enough to be in touch with both, he is evidently the pivot of the whole system; not only does the efficiency of the schools depend largely on him, but scarcely less important are his diplomatic duties in keeping the school in good odour with the local authorities, and getting them to help education over and above the legal minimum.

The Prefect, like the minister, has to assist him an advisory council of experts, called the *conseil départemental.* The educational element is in an immense majority on it. In fact, it is practically an education committee with no direct financial powers, the money being raised by the *conseil du département* (or county council) which has representatives on it. A comparison between the education committee under the Bill, and these bodies would be very instructive but would take us too far.

Under the academy inspector come the inspectors who have each a district to look after. We should regard them rather as sub-inspectors. Originally largely recruited from among the teachers, they are now, owing to the increased severity of the examination, practically taken from the ranks of the professors in normal schools, the heads of which are also recruited by the same examination. The examination itself is extremely stiff, especially the practical portion, and no one who is not a past-master in pedagogics and practical knowledge of school work has a chance of passing.

The mayor of the commune has various rights, including that of visiting all the schools in his commune. He is also supposed to summon the school attendance committees. The cantonal delegates are apparently meant to represent the popular and parental element. They may inspect the building, supervise the children's behaviour, but if present at the lessons given may not meddle with the teaching. The French have little belief in the educational judgment of the local butcher, baker, and candlestick-maker. These "lay figures" in more senses than one have even less authority than Mr. Balfour's managers. In fact, they have so little that one inspector described them to me as the fifth wheel in the coach.

The two principal things to note, as regards this apparently complicated machinery, are the smoothness with which it works — due to the clearness with which the function of each official is defined—and the enormous preponderance given to expert as compared with popular management. What we have to learn from France, as far as one can judge, is not to destroy our capacity for self-government, but to strengthen it by fortifying it on the expert side.

Clearness in function has led to clearness in finance. At present the State is the largest contributor; the income and expenditure of certain taxes formerly handled by the department and commune are now part of the central budget. At present the State pays the teachers' salaries, the county council pays for the upkeep of the normal schools, and the parish pays for the cost and up-keep of the school buildings. A few figures may prove of interest. In 1897 the State spent about 5¾ millions, and the communes over 2¾ millions. The normal schools have cost over 2 millions. The percentage of the cost of building and furnishing has been 40 per cent. for the State, 4 per cent. for the department, and 56 per cent. for the commune. The English parish has, therefore, had more to pay than the French commune. The cost of a place in the State schools has been £12, against £14 12s. 8¼d. in English Board Schools. The total cost of education in France a year, including lay and religious schools, is put at 11¾ millions, or, reckoning in interest on loans, 14 millions.

The efficiency of the French State teacher may be judged by the following figures. Less than 1-5th per cent. of the male teachers do not possess the brevet, and only 4½ per cent. of the female teachers are without it; 45 per cent. possess further the *certificat d'aptitude*. This can only be acquired after two years' work in the schools. The difficulty of winning it may be gauged by the fact that it generally takes teachers much longer to obtain it. I myself came across a teacher who had taken eight years.

Between 6 and 7-10ths of the present staff have passed through a training college. As regards the position of the State teacher in a village, it has, in some instances, been scarcely a bed of roses in places where a laicisation has taken place. Cases are not unknown where teachers have been stoned and boycotted, while *jehads* against the lay school have been preached by the local clergy. Happily this phase seems to be passing away, and any attack on the State school even in a catholic district would probably be *mal vu*. Otherwise the rural teacher's position is probably from a social standpoint more comfortable than with us. To begin with he possesses that indefinite prestige that attaches to all Government officials. Again the contour lines of the local society are less abrupt in France. They do not rise in the terrace-like fashion as they do in England with the labourers, farmers, parson, and squire, all more or less at different altitudes and elevations, with no definite ledge for the unfortunate schoolmaster to settle down on. At the present time there seems to be a growing shortage of teachers, as with us. This is being happily met in some departments by giving bonuses to those teachers who prepare pupils for the normal school examination. An idea has got abroad which rightly or wrongly asserts that the teachers are turning the children against the profession, though curiously enough they continue to send in their own.

The vast majority of normal students come from the primary schools. They are practically

recruited from the department in which the college is situate. When they leave the college they desire to settle in their own department, and look on being sent to a neighbouring department as a sort of exile. One often hears the departments spoken of as merely geographical expressions, yet it is evident that this homing instinct of the teacher is gradually giving each department its own educational physiognomy, and thus it is reserved for the primary teachers, whom an impartial philosopher might call the real children of the Revolution, to give life and personality to the administrative entities — into which their spiritual forefathers re-divided France more than a century ago. Curiously enough, while the teachers remain stationary it is the inspectors who move from department to department in France. This is the exact contrary to us, where inspectors are more or less stationary and teachers more or less on the move. This no doubt is largely due to the inequalities in local salaries.

From a financial point of view the French teacher does not seem to be so well off as the English, though some of the English are worse paid than some of the French. The English certified master obtains on an average £127 2s. 7d. The best French male teacher only receives in the country £80 a year; in the town he receives various extra allowances. On the other hand he is always housed free of expense, which is not the case with his English *confrère*. Again, he can add to his income by being secretary to the parish council, or by running evening classes. Living is probably as dear in France as in England, but the style of living is distinctly more economical, as a comparison between the salaries of French and English civil servants of the same grade would show. After 25 years' service the French teacher receives a pension, provided he is 55 years of age.

The housing question does not appear to be a burning question in the country as far as the head teacher is concerned. The chief grievance seems to centre round a matter that has lately been agitating Parliament, the matter of whitewashing. Members of the parish council, who only whitewash their own premises once in ten years, cannot be got to understand the necessity of such proceedings every other year for the school buildings. Assistant teachers, according to the law, have adequate accommodation, but in reality the two or three rooms they ought to have often shrink to a single room, and that sometimes without a fireplace. Ninety-five per cent. of the rural schools have gardens, not, as has been rashly asserted, for experimental purposes, but for the private use of the teachers. In the old days the teacher was the priest's man, and was obliged to sing, himself and his little ones, in the choir. To-day he is nominally his own master, but owing to his secretarial duties and his evening classes, he is probably as hard-worked as any man in the world. Yet the amount of grumbling one heard was very small. One comes across everywhere signs of the missionary spirit which the desire to raise the country after 1870, and the militant reforms of Jules Ferry, have produced. A National Union of Teachers has just been started, and the late Minister of Public Instruction, who rightly recognised in the teachers a sort of republican army of occupation, gave it a hearty send-off. Other functionaries may change their political colours, but it will take many years to make the vast army of teachers untrue to their salt. They are to my mind the sheet-anchor of the Republic, and the chief visible definite concrete expression of the nobler side of the Revolution's aspirations. Their relations with the inspectors are generally excellent. Their relations with the other grades of education are singularly distant. Still this has not been a defect in the past. It has enabled them to cut themselves adrift from a vast amount of scholasticism which pervades French secondary education, while social education and culture have penetrated so far into lower strata of French life, that the primary teacher has not suffered as might be expected from his isolation from secondary education. Lately the need of closing up the republican ranks has been felt, and a teachers' guild, to include teachers of every grade, has been started.

After the teacher, the school. Allusion has already been made to the law, that every commune must have, or share in a school of its own. So strong is local feeling that the united district comparatively common in England is rare in France. Only 2 per cent. of the communes have a school in common. One pig-headed commune with a school population of 5, insisted on building itself a school that cost £800. Such cases of obstinacy would be unheard of in England. The country is now covered with a complete network of State public schools. Out of 36,174 communes only 47 have no school at all. Communes over 500 are legally obliged to have a separate school for girls, and even this provision has been very thoroughly carried out. The

buildings generally are in a good state of repair. Of course, those built 70 or 80 years ago are less suitable than those erected 20 years ago. The school furniture is less satisfactory, but here improvements are being gradually made. An excellent idea is the distribution of large coloured illustrations by the Ministry, which are really views of French scenery procured from the railway companies, with, of course, the time-table part suppressed. These sheets add a certain amount of attractiveness to walls that are otherwise bare, for pictures to the country lad are as fascinating as flowers to the town child. We might almost look on them as the flowers of the town, fit subjects of barter for our rustic primroses and daffodils. The only piece of school furniture which need detain us is the *musée scolaire*, or school museum. One finds it everywhere. Its use has been admirably defined as the indispensable auxiliary of the real object lesson. It must not, however, resemble a curiosity shop, for collections formed at hazard, and with no definite plan, are of no utility. The museum must be appropriate to the teaching, not the teaching to the museum. The use of the museum will be well seen when we come to the agricultural teaching. Unfortunately, in a good many cases, it evidently was not utilised as it ought to be. Not a few that one saw resembled too much the collection at a marine store dealer's.

And now for the children. They were, for the most part, neat and tidy in their dress. Their hands especially were clean. The copy-books, which are usually a fair test in these matters, were singularly free from "tell-tale" finger-marks. Their behaviour, on the whole, was excellent. In the classes of one or two younger teachers one saw a certain amount of by-play going on, but that is the teachers' fault. This good conduct is the more surprising, as corporal punishment has been abolished in French schools, much to the dislike, it must be admitted, of the older teachers. But the younger generation seem to get on very well without it—in theory. In practice I should be inclined to take the word of a teacher, who said, "There is not a good master going who has not given a 'sound smack' to some child in his life."

How do the children attend? Well, that is a problem which would take up too much room to discuss fully. One can only give conclusions. To begin with, the attempt to make the duty of compelling attendance a local matter has been a failure. According to the law, the mayor of the commune was to summon the attendance committee and, if necessary, set the law in motion. A good many mayors did, with the result that they and sundry other zealous parish councillors lost their seats at the next election. Their fate has made the law practically a dead letter in the country. One of the chief sources of irregular attendance in the north-western departments is the departure of the children in the spring for the grazing districts, where they guard the cattle. These little *pâtours*, as they are called, often take six months' French leave at a time. Haysel and harvest, apple-picking and grape-gathering also produce irregular attendance. Several remedies have been proposed. Some have suggested that the teacher should be armed with the power of putting the law in motion—an evident mistake, as it would bring him in direct collision with the parents. A better idea is that of vesting these powers in the inspector, who is sufficiently highly placed to be beyond the reach of local vengeance. But while those in authority with whom one conversed, agreed that the law should be made more effective, they most of them deprecated any wholesate setting in motion of the legal machinery as likely to do more harm than good in the country districts, where the peasantry are by nature highly conservative, and local customs and prejudices are strong. One inspector, in particular, told me he had made a thorough trial of the legal remedies. It had been a complete failure. Then he had turned round and experimented with the system of allowing the teachers to inform the parents that the inspector would always favourably entertain a request for leave of absence if the work was specified. Eighteen years' experience had proved the system worked extremely well.

Another way of keeping on the children was to discourage them from presenting themselves for the leaving certificate before they were twelve. Much good is also done by those teachers who make personal inquiries of the parents whenever a pupil is absent. To render the system official, as some propose, would just destroy the whole value of it. It is appreciated, just because the teacher's act is voluntary. In some departments, the method is being tried of giving bonuses to those teachers who improve their attendance average, and also of taking the fact into account in regard to promotion. The practice has been followed by excellent results, and is one we might well copy. It is

suggested, too, that the little *pâtours* who are miserably paid, might be kept on at school, if the *caisses des écoles* were sufficiently well organised to give the poorer parents an indemnity equivalent to the wretched pittance these children earn, but what the big graziers would say who live in districts where there are no hedge-rows, must be left to the imagination. Speaking generally, though the attendance is likely to improve in the near future, it is clear that the French problem will need delicate handling for long to come, and that the method of adaptation to local needs, whether by the half-time system or by allowing the parents the use of their children's services at certain times of the year, will be the policy pursued.

Coming to the organisation of the schools. We find them officially divided into three *cours* or grades, the higher for children from 13-11, the middle for those from 11-9, and the elementary for those from 9-6. The higher *cours* are generally a blank in rural schools, as the children in the *cours moyen* leave *en masse* after taking the leaving certificate; while it has been found necessary in practice to intercalate a *cours préparatoire* between the *cours élémentaire* and the *classe enfantine* for children under six where it exists. Classes over fifty have a right to an additional teacher, but the regulation is broken in 8,422 schools. Morning school starts at 8.25 as a rule and finishes at 11.30. Afternoon school (or evening as it is called), a reminiscence of the time when people dined at 10 a.m. in the morning, begins at 12.55 and lasts till 4 p.m. There are intervals for recreation in the middle of both schools. Thursday is a whole holiday. Monitors are not officially recognised, but one found them in about three-quarters of the sixty schools one visited. In the mixed schools it would seem quite impossible to do without them. They are not, however, paid, but the top pupils in the highest class are put on for the day or the week to do the work.

The curriculum includes moral and civic instruction, which thus head the list, reading and writing, arithmetic and metric system, the French language, history and geography, both mainly French; object lessons, elementary scientific notions, the elements of drawing, singing and manual training, principally in their application to agriculture; military and gymnastic exercises. Each *cours* or grade is supposed to be a stepping-stone to the next, but the programme except in history and in geography is concentric not successive, that is—the pupil is introduced to all the subjects at once, but every year the circle of his knowledge in each is widened. The elementary grade is pre-eminently that of initiation, includes the acquisition of the technique or tools of knowledge—reading and writing. The aim of the middle grade is the foundation of the scientific basis of knowledge, and in the higher *cours* the objective is the development of the logical faculty. The time-table is arranged on the system of putting the harder subjects in the morning. Teachers may vary the order of subjects in the time-table, but the hours assigned to the principal subjects is largely the same in all schools. It is only in such subjects as manual training and singing that some option is exercised. The school work is plotted out with a definite quantum for each month; the last month, July, being devoted to revision. This "time-schedule" is rather intended to indicate the rate of speed than to tie down the master to the exact points to be taught. The aim of the whole programme is to teach thoroughly, not to teach a good deal superficially, and to cultivate the imagination rather than to overload the memory. The latter is still the besetting sin of the religious schools, but the State schools have certainly broken away to a large extent from the catechismal method of set question and answer, and the learning of neat and, often to the child, meaningless formulæ by heart. Yet there is still a tendency to turn out intelligence on a general pattern, rather than to develop the individual intellect or let it grow as it will according to the pedagogy at present in vogue in America. Still here a foreigner must be cautious of judging, remembering that the French mind takes to logic as a duck to water.

To discuss adequately the teaching of *la morale* would require a separate paper. Here again an Englishman who is mainly swayed by his feelings or by facts cannot easily understand the force of an ethical system which grounds itself largely on an appeal to reason. In France, the belief in reason is part of and parcel of French civilisation. As an Englishman appeals to experience, a Frenchman appeals to reason. It is to him a cult, a dogma, a religion. None the less for children of tender years it needs a large admixture of the emotions. One thing is certain. Where the teacher is a strong believer in what he teaches, there he finds apt disciples. Whether the French were right to break thus definitely with the past by deliberately excluding all religious

teaching is not for a foreigner to decide lightly. One cannot help thinking that they might at least have first tried the system of allowing the priest access to the schools during certain hours.

The writing appeared to me unusually good. The teaching of arithmetic is excellent. The method employed throughout is that of making the child explain at the side every step he takes. The inspectors are dead against what I would call the cookery book system of working out an example on the board by way of recipe and the setting the children down to do others like it. Again, all sums have to be concrete ; either about the number of cows in a yard, or the cost of a pound of butter, &c. There is no juggling with abstract figures. But the chief advantage of all is that the pupil works with the metric system. Thanks to the latter every pupil obtains a definite notion of superficies and volume, which our unfortunate children can never get from our kaleidoscopic weights and measures, in which gills are metamorphosed into pints, pints into quarts, quarts into gallons, at which point a new bifurcation comes on for wet and dry measure. The result is that the English child never realises that there is any such thing as a scientific unit of dimension, but vaguely imagines that measures are a mere affair of pots for wet things and pans for dry. Composition is better taught in the French rural school than with us, as more stress is laid on making the essay a whole in itself. Still it has suffered in the past, and still suffers from excessive attention being paid to minutiæ in spelling in spite of the recent reforms. Geography begins with elementary notions of the world, and of the meaning of a map. It then comes back to the starting point in English and German schools, the schoolhouse and its environment. An excellent practice obtains in some schools of hanging up maps made by the teachers of the department or commune either geographical or agronomic. History is too much of the blood and thunder type which breeds young fire-eaters, though the social and economic side is being gradually developed. Manual training is practically a dead letter in the country. In one village I went into it had been suddenly dropped. The local authorities who were delighted by the great progress shown by the children at their home-work, discovered that the village carpenter was making a handsome thing out of doing their work for them. Military exercises have caught on, but little in the country ; singing in the departments I visited was much neglected. In domestic economy the French have nothing to teach us. They have not yet determined its place in the curriculum. The sewing is probably their strongest point. I only saw one cookery lesson, and that was given out of a book. The teacher described the roasting of a fowl to the class. A series of questions that followed showed the children had only retained half the directions. It is to be hoped for the peace of the future households over which they will have to preside that they have already forgotten the other half.

And now we come to the subject which, perhaps, is of most interest to us here in England to-day, the so-called teaching of agriculture. Before, however, discussing the French solution, it should be remembered that the rural problem in France and that in England differ in certain radical particulars. Hence, what may suit France need not necessarily suit England, and *vice-versâ*. To begin with, it must be remembered that the rural population in France outnumbers the urban, whereas in England it is just the other way. Accordingly country interests in France have had a greater chance of making their wants heard and attended to than with us. The French rural problem has therefore been tackled at least ten years earlier. Again England is rather a country of large farms, France of small holdings. In England the bulk of the village community are landless men, save the squire, parson and farmers, whose children do not frequent the village school. In France, in some communes, one person in every four is a proprietor, and therefore the pick of the village scholars are the sons of peasants who have been helping their fathers on their small holdings from their earliest years. Hence while the problem in England seems to be to stimulate observation and dexterity, to provide at most an eye and hand training in order to improve the future labourer's efficiency, in France, rightly or wrongly, the aim has been to give the pupil some grasp of the principles underlying the science of agriculture.

The first attempt to develop popular agricultural teaching in the primary school goes back to 1866, but nothing was really done till the law of 1879, which started agricultural teaching in the normal schools and made it compulsory after three years in the elementary schools, each departmental education committee being left to draw up its own agricultural programme.

Unfortunately this local option in programme making seems to have produced more harm

than good, for the reason that the aim and first principles of the subject had not been thought out. A visitor to France in 1891 found no less than six conceptions of agricultural teaching in existence. The first consisted of stray notions on the subject being given by the teacher, often out of a book, supplemented by passages for dictation culled out of the agricultural journals. The basis of the second was the lecturing by heart of little agricultural catechisms, in which the horse was defined as a four-legged animal, and the obvious and the abstruse were delightfully jumbled together. The others were variations of the gardening method, the fullest being that in which each child had a plot, and cultivated another in partnership with his fellows, under the eye of the teacher. In 1895 the Ministry took the matter in hand, and order was evolved out of chaos by the celebrated scheme of January, 1897, "On the teaching of elementary notions of agriculture in rural schools." The method was to be notions of science applied to agriculture, and the procedure was to be above all practical. The aim was to inspire children with a love of the country life, and convince them of the superiority of an agricultural occupation for those who practise it with industry, intelligence, and enlightenment. Teachers were advised to give the whole curriculum an agricultural tinge, and to make their lessons in agricultural teaching coincide with the seasons. Inflated programmes were deprecated, and suggestions for a course offered. In the elementary grade only simple objects should be given. For the middle grade there should be more object lessons, together with reading lessons and school walks. Simple experiments in the three states of matter, the study of useful and noxious plants, of combustion, of composition of soils, &c., should be included, as well as experiments with different manures, including the fivefold experiment with the different chemicals necessary for the support of plant life, potash, superphosphate, and nitrate. The need of *champs d'expérience* or trial fields is also insisted on. An inspection of the present departmental programme reveals that they are all maxima programmes. In fact the teacher is not so much supposed to follow them implicitly, but rather to pick and choose those portions which best suit his own district, be it a grazing or arable country, a wine or a cider district. Another point which an inspection of the programmes brings out is, that though the majority of them are far more practicable than the old programmes, there is still doubt whether the scientific and general side, or the agricultural side, should predominate.

These programmes are meant for boys, but girls are also taught horticulture, a matter the French peasant largely leaves to his womankind. They are also given some instruction in poultry keeping and dairy work.

As regards text-books their employment is well defined in the Calvados programme. "Books will be useless in the *cours élémentaire préparatoire*; optional in the *cours moyen*; indispensable in the *cours supérieur*." The work placed in the hands of the pupils will only serve for reference. In no case will it take the place of oral teaching. Of those who would do entirely without books, one is compelled to ask what is the use then of libraries? Pictures, diagrams, and the *musée scolaire* are all useful adjuncts to the teaching of the subject.

But, as the Ministry have recognised, the chief value of the subject lies on its experimental and practical side. The experiment in pots is pretty, but insufficient; more fruitful have been the outdoor experiments in the teachers' gardens, or in the *champs d'expérience*. In two directions the school has been able to render valuable service to the cause of agriculture. One is the teaching of grafting in the vine districts, where the reconstruction of the vineyards is of capital importance, owing to the devastation of the phylloxera; and the other is the wider and more intelligent use of natural and especially artificial manures. The employment of the latter is especially needful in a country where the head of stock kept by the peasant is comparatively small. The agricultural education of the department outside the primary school is one of the many functions that concern the professor of agriculture, but, in looking after the "trial fields," the teachers often prove to be his most valuable henchman. In some departments these *champs d'expérience* are quite insufficient. In Calvados, for example, there are only some 20 or 30 in 763 communes. In Sarthe, on the other hand, with 386 communes, they numbered 167 in 1898-9, of which some 80 were looked after by the teachers. A further aid to the outside work of the school is the school journey, during which the children take notes, and occasionally botanise.

To sum up, while the older teachers seem generally indifferent, there are many among the younger generation who, thanks to the

teaching in the normal schools, take a keen interest in the subject. The chief desideratum seems to be the establishment everywhere of a small garden. This is so strongly felt by the Ministry that at the Exhibition of 1900 there was a small model garden which, though it occupied only some 75 square yards, allowed room for a largish number of experiments. Most of tbe plants it contained came originally from school gardens. The botanical bed in the middle was composed of field flowers. It sufficed, as the official report says, for the study of the principal families, and was none the worse for being ornamental. In the foreground was a narrow bed containing the principal leguminous and gramineous plants that every cultivator ought to know. To the left, five little squares were sown with mixtures of these plants in order to form specimen meadow plots. Behind them were four quadrangular plots sown with maize, potatoes, tomatoes, &c., each being treated either with no manure, or with different dressings to show the effect of proper manuring. Against the wall at the side were climbing plants, vines, and fruit trees. In spite of the torrid heat and the attentions of the Paris sparrows, the garden looked very well, and the experiments were most satisfactory. Some English critics, no doubt, will not be able to completely approve of the French solution, though experiments on more or less similar lines have been carried out with much success in this country, notably by the Surrey County Council, in Norfolk, and the Isle of Wight.

It is possible that the advocates of Nature study would insist on the superior educational value of an education whose first principles are rather based on training the observation and the imagination. The French system bears on the face of it a practical and utilitarian aim. Yet any judgment passed upon it must take into consideration the requirements of the French rural problem.

To encourage the teaching of the subject in the rural schools, examinations written and oral are held, and prizes awarded by the different departments. The examination papers include questions framed on the missing word principle, questions demanding an answer of two or three lines, agricultural book-keeping, which is really a short problem in arithmetic, an essay, and a simple design from memory. In Sarthe, there are not only school examinations but school exhibitions, which are apparently very successful. Prizes are given by the local agricultural societies – a point that might well be copied in England.

The French programme, as the examination paper just quoted shows, attempts as far as possible to dove-tail the subjects into one another. As was indicated at the outset, a subject is not so much squeezed into the curriculum because it "pays" or because it is a fad. To gain entry it has to prove that it will better the all-round efficiency of the pupil. None the less there is a general feeling that the curriculum is overloaded, which is plain, when, as we have seen the school working-week is 30 hours, and the number of hours required by the subject is 34. French teachers are already asking whether the wisest thing would not be to have the main programme the same for town and country with certain optional subjects for urban or rural children. The teachers themselves favour some such form of decentralisation, and probably some sort of restricted local option will be possible in the near future.

As a sanction to all these studies, the French have created a merit or leaving certificate called the *certificat d'études*. It has its drawbacks, the principal one being the premature age at which the pupils take it, with the result that it leads to cramming. Yet on the other hand it is held in high esteem by parents and by the business world. It also gives the State a valuable means of audit, all the more valuable because part of it is oral. Happily, in France, the fetish of paper-work has not reached the dimensions it has with us. The French have all along seen that *viva voce* is an indispensable supplement to a written examination, because it tests qualities which are of real worth in daily life, presence of mind, power to mobilise one's knowledge and intelligence at a minute's notice, and to think out a problem quickly. Paper work is a good test for the closet student, the recluse, but oral examination brings out as no other test the strong points of the business man who has got to keep his head and to come to a sound decision—more speedily than his fellow competitors. In any case, the advantages of the examination appear even in the teacher's eyes to outweigh the disadvantages. For those who would learn more of its working I must refer to an excellent monograph on the subject by Sir Joshua Fitch. If such an examination were adopted in England it would probably be best to entrust it to a board, consisting of the inspectors, with representatives from primary, secondary, and technical schools and com-

mittees. Were the examination conducted by districts in the counties and by group centres in the large boroughs, the whole examination could be got through generally in a single day, provided the examining board were big enough.

Most of the foregoing remarks refer to the State lay schools, as the religious schools in the country are comparatively few. Their strength lies strangely enough in the towns where they can charge fees. In teaching methods they are and have been generally inferior, but this is scarcely surprising when one realises that they are entirely self-supporting. The intolerable strain with them is not some 20 per cent. of the maintenance, but 100 per cent. Under these circumstances one can only admire the spirit of self-devotion that keeps them alive. Many will probably go under owing to the financial strain, quite apart from any alterations that may be made in the new law on the right to teach.

The agricultural training given in the normal schools is naturally of vital importance to the rural school. While it appears to be sound upon its normal side, it probably still requires a good deal of attention to make its practical side as effective as it might be. The truth is in many cases the agricultural professors are so hard-worked they have not the time to pay the requisite attention to their out-door courses at the normal colleges, and, on the other hand, there is not always that close correlation that ought to exist between the teaching of the agricultural professor and his *confrère* the professor of science. Agricultural teaching in the training colleges for women largely consists of horticulture.

The chief lesson to be learnt from the French training colleges is that we must copy them in immensely increasing our facilities for training, while we must avoid their mistake of setting up a brace of normal schools for each county or department. What our authorities should rather do is to group their schools round the universities or existing training colleges, or perhaps in the case of some of the rural counties build small hostels round some of the agricultural colleges, which the students could attend for certain courses; while in other respects they would receive a literary training. In any case, we want on the one hand to centralise the training centres, and on the other to encourage the counties to go shares as much as possible in the building of new schools, or at least, to place their hostels alongside one another round a nucleus of classrooms and school buildings to be used in common.

The opportunities for agricultural education in secondary French schools are so insignificant they need not be mentioned. The local grammar schools are far more out of touch with the localities than with us. Far more promising is the creation of ex-standard classes and higher primary schools in the country districts with a view to catering for rural needs. This is a species of school which it ought to be easy for the rural counties in England to erect in the near future. Only the authorities must steadily bear in mind what sort of pupil they mean to produce, and to be certain to produce one who will not be a *déclassé.* But the rural problem in France is complicated as in England by class distinctions. Parents will still go on sending their boys to the religious high school or the college because it is the fashion. The remedy in both countries, therefore, seems to be to modernise the college course and make it give, as the great majority of country grammar schools should give, a thoroughly modern education. The scholarship system properly arranged should provide for moving on a clever lad to some central county school which prepared for the universities on classical lines. If a classical side exists in such schools, it should really be a side and not the main aim of the schools. These schools had a regular *raison d'être* to be classical schools in the days that the local upper ten frequented them. But with the revolution of transport, their *clientèle* has greatly changed, and the education they give should follow suit.

Of the extraordinary ardour with which the French teachers have thrown themselves into the extraneous work connected with the school, a few words must be said. Many of these works of superogation are performed by the English teacher, but nothing like to the same extent. One thing we might copy is the *mutualité scolaire*, or the system of old age pensions, which starts in the elementary school. Had the children's fees in English schools been devoted to this purpose instead of being abolished, we might have created with a stroke of the pen a complete system of old age pensions. Allusion has been already made to the evening classes and lectures carried on by teachers in connection or not with old boys' clubs. Some idea of the magnitude of the work may be gathered from the fact that in 1900 the number of

people attending these lectures amounted to 3½ millions. It is not necessary to dilate on the value of these good works in bringing together parents and teachers in the rural districts, in brightening village life, and in stimulating and consolidating village interests. Let it suffice to say that in many places it is helping the school master to become the "lay rector" of the parish.

Such then is the sketch of the French school and especially of the French rural school I have to offer you. Incomplete and superficial as it is it may nevertheless perhaps produce on you some faint impression of the effect it produced on me by the thoroughness of the organization, by the capability of the expert element in supervision and guidance, by the rare enthusiasm and self-devotion of the teachers, and by the correlation of subjects and the coherence of aim that distinguish the curriculum of the primary school. Of course there are blots, in some places the supeivision is too drastic, the intrusion of politics too obvious, the teaching is lukewarm, and part of the programme remains unrealised. But judged *en bloc*—and I think my opinion will be endorsed by my colleague, Mr. Medd, of whose competence I do not need to speak here—the general efficiency of the school is certainly remarkable. Mr. Medd and myself wrote entirely independent reports, yet anyone must notice that on all great questions we somewhat arrived at practically identical conclusions.

And this brings me to the last and most difficult part of the problem. How does the school stand in relation to the rural problem? Is it a power for good, or does it merely help to accentuate the rural crisis? Judging by what I saw, and heard, the French school is not out of sympathy with the home. At the time of my visit its struggle with the Church was distinctly on the wane, while the school is certainly in good odour among the vast majority of country folk. The great mass of those one interviewed assuredly did not look on it as an engine for setting boys against the land or increasing the longing for town life. Yet so much has been said, often unfairly, against the English rural school; such extravagant ideas have been advanced about the extent of its evil influence, that a statement of the French rural problem may help to open the eyes of those people who apparently think that a few changes in the school curriculum would prove a "cure-all" for every ill the countryside is heir to. Let us first consider, very briefly, the French rural problem, and then we shall be able to see whether and to what extent the school exercises an alleviating or an aggravating influence.

Here again of course one can only speak of the five departments which one visited; yet lying as they did on the borderland between north and south they are probably typical of a great many other departments.

Speaking, broadly then, local industries except when grouped round centres like Flers and Lisieux seem to be declining. The village industries, once such a feature of these parts, are practically extinct. Agriculture while not the prosperous thing it was under the Empire (a matter that still makes the older peasant a Bonapartist at heart) has certainly improved during the last ten years, though land has fallen one-third in value. In many places the yield per acre of corn has doubled, thanks to the use of artificial manures. Dairy farming and cattle breeding are flourishing, exept where the foot-and-mouth disease is prevalent; but the great change from arable to pasture has had a bad effect on the peasant. It has made him more lazy than he was. Horse-breeding, especially for the remounts (the French prefer encouraging home industries to buying "screws" in Hungary) is a paying business, and hundreds of thousands of fowls and millions of eggs are sent from these districts to Leadenhall Market. The cider districts are the most prosperous in France. If the apple crop is a failure owing to the wet, the hay crop grown under the trees is usually heavy: if the season is too dry for hay, the apple crop is a bumper one. The vine districts seem to have turned the corner, and nearly everywhere vine-growers are making money. The new method of replanting and grafting have robbed the phylloxera of its worst terrors. Agriculture has been immensely aided by the establishment of agricultural professors, who not only conduct local experiments but analyse soils, suggest the proper manures, and encourage co-operative purchase on a large scale. Much again has been done by the construction of light railways, the foundation of agricultural shows, the creation of syndicates among the farmers for buying manures, implements, and pedigree bulls. Some of these societies run into thousands of members. Mutual assurances against loss of crops or cattle are very widely practised, although co-operative selling is in its infancy. But *le manque de bras c'est la plaie du pays.* Labour is getting ever scarcer. The harvests

would stand rotting in the fields if the foreigners did not arrive in shoals to reap them or the Ministry of War did not allow the soldiers to go and lend a hand. Still the sons of the land-owning class no longer flock to Paris as they did. But the landless men still go. The attractions are higher wages, the glamour of town life and conscription. Half the rural conscripts, says one authority, never come back to till the soil. Those interested in preserving our village life had better note this when they hear conscription mooted in England. Another cause of the depopulation is the low birth-rate. This is due in part to the love of comfort which restricts the number of children in the family, and to the absurd system of inheritance. The English system of primogeniture, says a witty Frenchman, confines the number of fools to one per family, we French have found a method for rendering the whole family imbeciles. Certainly the division of property in assuring to each child a pittance, is a great incentive to slackness and lack of enterprise. But the chief cause of depopulation is alcoholism. Fifty years ago France was probably the most temperate country in the world. Now it is by far the greatest consumer of alcohol. According to statistics France consumes annually 14 litres of pure alcohol at 100 per cent. per head. We only come a bad sixth in the list with 9·23 per cent. but even our record looks black beside Canada's 2·63 per cent. The cause of all this paradoxically was the phylloxera, which, by making wine comparatively dear, drove the people to beetroot spirit, absinthe, and other deadly poisons. The effects have been appalling. In Rouen a workman's morning breakfast often consists of slices of bread served in a soup tureen containing a litre or half a litre of spirit; the coffee even is left out. The same soup is not infrequently served at the evening meal, and this is the fare the children are brought up on. The whole race seems threatened. In the fourteen years between 1874-1888 the number of recruits in the Northern Departments unfit for service has increased sixfold, and in the district of Domfront there are some cantons in which, owing to the prevalence of alcoholism, the recruiting of young conscripts is becoming almost impossible. The asylums are filled up with these alcoholics. In that of Alençon 60 per cent. of the males and 70 per cent. of the women belong to this category.

In the light of the above facts it is clear that the higher primary school may do something for industry; the agricultural education given in the primary and higher schools should make the pupils they turn out more anxious to follow the profession of their fathers and to profit by the services of the agricultural professor. But the other problems are clearly beyond the competence of the school to solve, except that of alcoholism, and here the teachers, though rather in the towns, have already started a vigorous campaign to rouse the younger generation to its dangers.

So much then for the school and its services to the locality. But the French, while not unheedful of local needs, none the less recognise that the school has also a national and a world-wide aim. They do not forget that it is the nursery of the citizen of to-morrow, and true to the teaching of the French Revolution they are far from neglecting the claims of humanity. While the French secondary school represents in some ways the quintessence of the culture of the past, the French primary school embodies to a certain extent some of the newest and most modern ideals in education. Their ways are probably not altogether our ways. Their aims may differ, but the principles they have set before them seem well worthy of our consideration and imitation. They desire to give the pupil a practical education, to render him as much as possible in sympathy with his present and with his future surroundings; but they none the less desire to keep his education general. They do not degrade the literary side of the curriculum, but transform it by choosing more suitable subjects. They try, in a word, to combine the education of the enlightened worker with that of the enlightened citizen.

DISCUSSION.

The CHAIRMAN said he knew of no one more qualified to speak on the important subject of rural education than Mr. Brereton, who had made an investigation of the subject on the spot, and had possessed facilities which were denied to many other people, being an expert French scholar and qualified in other ways.

Mr. J. C. MEDD said with regard to elementary schools, he did not think that the French school had anything to teach the English. Frequently there was a better system of teaching and better co-ordination of subjects in France, but with regard to agricultural instruction he thought the English schools were at the present time conducted on the right lines.

The French admitted that they did not teach agriculture in the schools, but taught horticulture to a limited extent. The object of the elementary school was not to give specialised instruction, and the only subjects which should be introduced into elementary schools were those calculated to develop intelligence. He quite saw the necessity of introducing subjects which developed powers of observation, and, what was most important, to awaken the child's intelligence. It had been said that man had a good deal of curiosity, but very bad eyes. At the same time there were some things in the system of French primary education which Englishmen could well imitate. In the evening schools instruction became technical and utilitarian. He wished local authorities would take a lesson from France in encouraging and developing English schools as the schools were developed in France. The extraordinary growth of such schools across the Channel was entirely due to the voluntary effort of the rural teacher, and of this no one could speak with too much admiration. Often those evening efforts were not rewarded pecuniarily at all. He regretted that the Bishop of Winchester's amendment was not carried last night in the House of Lords. He thought attendance at evening schools ought to be made compulsory for two or three years, in the interest of the people themselves. He saw no reason why in England there had not been an additional class, an extra standard for children under the age of 15, added to a conveniently situated school in the district. Such provision enabled children to be benefited by proper instruction up to the age of 15. That kind of thing had been successfully carried out in Scotland, and should be equally possible in England. He thought the advanced schools should be divided into three sections: an agricultural section, a commercial section, and an industrial section. One might find schools with an agricultural tendency in the country, and with a commercial tendency in towns, but there was no reason why schools should not have each of those three divisions. For the first year the education would be the same for all, and at the second and third years the lad would specialise as he wished. A committee of the Central Chamber of Agriculture had just considered the question of the rural school in relation to the rural exodus, and it would have been an advantage if that committee had heard Mr. Brereton before their sitting.

The Right Hon. JESSE COLLINGS, M.P., disagreed with Mr. Medd when he said that the teaching of agriculture should not be given in the rural elementary schools. He thought that was just the place in which that education should begin, when the child's mind was in a pliable and receptive condition; thus would be implanted in the child's mind at the earliest moment a love for the country and everything rural. Could there be a greater means of increasing powers of observation and increasing intelligence than by teaching all those methods grouped under the term agriculture connected with the produce of the land, and could there be a more elevating thing than to take young children, and show them how the natural processes worked? At present, if one asked a child who was regularly attending school to name the first tree he saw, he shook his head, and the same result occurred if he were asked to name the birds, or the various grasses, or the flowers in the hedgerow. Having laid the groundwork, the children would be so fascinated with the study that they would continue it in the evening continuation schools. At present, when they left the primary school they went into an occupation which took up all their energies, and not having had a love of the country implanted in them, they migrated to the town, and the country knew them no more. If the boy had remained in the country he would not only be getting a living but enjoying it. But the great point was to be able to hold out some good feature, some prospect other than that of being mere wage receivers. He would have a school-garden connected with every rural school in the country, where there should be crops, seeds, fowls, rabbits, a pig, and other types of agricultural work. If such children could see a prospect of becoming cultivators later in life, not only would the exodus from the country to the town be stopped, but the balance would be turned the other way, and people would return to the country from the towns. Only thus would many of the terrible social problems be solved, such as overcrowding. He trusted that local authorities would have the sense to introduce that form of education in every rural school in the country.

Mr. FRANCIS OWEN joined in the regret at the enormous change which had come over the country in regard to the subject under discussion. He thought children were deteriorating in intelligence, because they did not now seem to think for themselves. He believed they should be taught how to study a text-book for themselves; they should be taken carefully through it, and the various points explained in a way which would help them to elucidate a subject for themselves. He related his experience as a chairman of a technical education committee, and pointed out how deficient in Third Standard subjects some of the boys were who had passed the Sixth Standard, and been employed for an interval since.

Mr. MARK WEBB suggested that as the word agriculture had been somewhat objected to, the American term, "Nature study," might be employed. It had been mentioned that children might be taught to think, but the child would not think unless something attractive was provided for him to think about. With regard to Mr. Brereton's mention of starting hostels round agricultural colleges, as in Surrey, Mr Macan had said that special authorities, supported by special County Councils, should be brought into

existence to do that particular work. He (Mr. Webb) had had the privilege lately of hearing and seeing explanations of a great deal of the work which had been done in England, and he could never have hoped that so much could have been done so suddenly.

Sir EDMUND HOPE VERNEY, Bart., said that last summer he made the acquaintance of several schoolmasters in France, and he could corroborate the remarks as to the admirable spirit which animated them, and the great desire for education there was in France. In one of the poorest quarters of France it was the practice to send a thousand children every summer, at the public expense, into the country districts, at a cost of £2 per child, and he did not know of any parallel to that remarkable action in this country. In England, in the rural districts, everyone hated education. The labourer's wife came with tears in her eyes to beg that her children might be excused from school so that they might earn a little pittance in the field. The farmer complained of his labourer, who knew as much as he knew himself, which would never do. The squire and the parson also hated it, and the clergyman's wife, who was generally about the worst of the lot, said "What are we going to do for servants?" He had heard eloquent speakers in the country move meetings one way or another, until they came to the subject of education, and then it was evident that was not wanted, and it was obvious that a wet blanket had been thrown over the meeting. Each speaker seemed to dwell upon the importance of developing the intelligence of the child, and the only difference was as to the way to do it and its effect. He disagreed with Mr. Jesse Collings, because however their eyes were opened, when that was brought about the young men were not such fools as to remain in the country. There was no hope for them, and no prospect. What went to the root of the whole matter was the need for a radical reform of the land laws, without which the troubles in connection with that subject would not be solved, and people would not be prevented from going to the towns, where they were free, and found careers open to them.

The CHAIRMAN said we could not be said to have developed any system in this country in connection with the subject under discussion. No system of any other country should be copied, because systems must be evolved according to the natural character and surroundings of the people. Having regard to the great progress which had been made in national education during the last ten years, he thought before another ten years there would be a system of education in this country which would compare most favourably with that of any other country in the world. He agreed that the primary school was not the place in which technical instruction must be given, but in which introductory instruction must be provided. He agreed also with Mr. Jesse Collings, that the intelligence of children should be so awakened as to enable them to take a very great interest in agriculture, which was best done by cultivating the system of "Nature study," that elementary knowledge which could be developed later in technical pursuits. He thought the so-called technical education question had not been solved either here or in France, and the French did not manage such things any better than we did in this country. He thought the solution lay in training teachers who should be competent to give the instruction required, and then there could be established rural schools with a proper curriculum.

A vote of thanks having been passed to Mr. Brereton, was briefly acknowledged by him.

Miscellaneous.

OLD AGE PENSIONS IN NEW SOUTH WALES.*

In New South Wales the Old Age Pension Act of 1900 was assented to on the 11th December of that year, but the first payments of pension claims were not made till the latter half of 1901. A successful applicant for a pension must have shown—That he is at least 65 years of age; is residing in the State on the date when he makes good his claim to the pension; has been residing in the State for not less than twenty-five years immediately before that date; that during the twelve years immediately before the date when he makes good his claim he has not been imprisoned for four months, or on four occasions, for any offence punishable by imprisonment for twelve months or more; that during twenty-five years immediately preceding the date of his claim he has not been imprisoned for a term of five years, with or without hard labour; that, if he is married, he has not at any time, for a period of six months or more, deserted his wife, or without just cause has failed to provide her with sufficient means of support, or has neglected to look after such of his children as were under the age of 14 years; that he is of good character, and is leading, and has been leading for five years at least, a sober and respectable life; that his income does not amount to £52 a year or more; that he has not deprived himself of income or property in order to qualify for a pension; and that, if a naturalised subject, he has been naturalised for at least ten years before the date on which he claims his pension. No alien, Australian aboriginal, or Asiatic, is entitled to a pension. A person of 60 years of age or more, and yet under the age of 65, may obtain a pension if he is unable, through bodily ailment or defect, to earn his own living, and if he, in all other respects, fulfils the conditions stated above. When

* Communicated by Mr. John Plummer.

the claimant has satisfied himself that his claim is a proper one, and can be established, he must send the form of pension-claim, properly filled up and with the declaration upon it witnessed, as required in the form, to the clerk of the nearest Court of Petty Sessions, or to the Deputy-Registrar for Old-Age Pensions for the district. The claim will then be examined by the District Board for Old-Age Pensions, and the Board may require a claimant to appear before them personally, or to produce further evidence with regard to his claim. If he receives an intimation from the Deputy-Registrar that he is required to appear before the Board or furnish additional evidence, he must be prepared to satisfy the Board in regard to his claim. The Board may authorise some officer to make inquiries, and in that case he must give the officer any information he can. When a pension-claim is admitted by the Board, the Deputy-Registrar issues a pension-certificate to the claimant. If the Board does not grant the pension the claimant may appeal against it, but he must do so within one month after the Board's decision on his claim has been made known to him. He can get the necessary form for his appeal from the Deputy-Registrar of the district on applying either in person or by post. After properly filling the form, the claimant must send it to the nearest Clerk of Petty Sessions, being informed of the result of his appeal in due course. The fact of a man having been granted a pension will not prevent his wife obtaining one also if she is 65 years of age and otherwise eligible. Where the pensioner has an income of over 10s. a week apart from his pension, a deduction from his pension is made according to a scale fixed by the Act. If the pensioner has property over the value of £390, a deduction will also be made on that account. Since the pension is for the personal support of the pensioner, it cannot be transferred to any other person in any circumstances, or attached for the purpose of meeting the pensioner's debts. Six months' imprisonment is the penalty which may be imposed upon any person who tries by false statements to obtain a pension to which he has no claim, or one of a larger amount than he is entitled to. No pension can be given to any person who is kept by a charitable institution, or who receives relief from one, unless such a person suffers from some bodily defect or ailment which prevents him from taking care of himself. In such a case the reasonable cost of his keep or of the relief he receives will be paid out of his pension. According to Mr. Coghlan, the State Government Statistician, the number of claims received under the Old Age Pensions Act during the six months of 1901 in which it was in operation was 28,709, and of these 22,113 were allowed by the district boards adjudicating on the claims. During the same period the number of deaths of pensioners was 543, so that the actual number of pensions on December 31st was 21,570. The total sum payable in respect of pensions on the same date was £500,334, so that the average amount of each pension granted was £23 4s. per annum, or 8s. 11d. per week. The pension list is growing rapidly, as a large number of persons eligible delayed making claims; and on the 31st March, 1902, it is estimated that 22,500 pensions were payable, involving a sum of about £521,900.

IRRIGATION IN SOUTH AFRICA.

The following notes on the importance of irrigation for the supply of water to the gold mines are from the Report of Sir William Willcocks, K.C.M.G. :—Valuable as water may be for agricultural purposes, it is a thousand-fold more valuable for gold washing at the Rand mines. The gold-bearing strata are singularly free from water, offering in this respect a marked contrast to the dolomite which lies just above them. As I understand, about seven cubic feet of ore yield £1. To wash out this gold there are needed ten tons of water for each ton of ore. A ton of ore may be taken as twelve cubic feet, and a ton of water as 35 cubic feet. Of the water used, one-fifth is permanently lost, and the remaining four-fifths are used again. From these data it results that forty cubic feet of water are needed to work out £1. Now in the dolomite region we may say that 150,000 cubic feet of water will be needed to irrigate one acre of land for one year, of which the nett yield may be taken as £5. In other words, in agriculture 30,000 cubic feet of water will yield £1, as against 40 cubic feet in the Rand mines. As the Rand mines are the principal source of wealth of South Africa, it is only reasonable that round Johannesburg all agricultural interests should yield to the gold mining interests during the life time of the mines. Now the Rand mines produce £20,000,000 of gold per annum, and need 800,000,000 cubic feet per annum, or 25 cubic feet per second. Up to the present the water needed for the mines has been obtained partly from the mines themselves, partly from the numerous reservoirs on the steep sides of the hills round Johannesburg, where the most considerable reservoir dam is a 40 feet high wall of masonry, partly from a well south of the Klip River, and partly from the Johannesburg Water Company. During years of deficit rainfall the mines are put to great difficulty to meet these demands for water, and sometimes they are put to considerable loss, while tens of thousands of workmen and plant lie idle. It is, moreover, contemplated to raise the output of the mines to £40,000,000 per annum. To increase the output certainly, and to insure the present working of the mines even, it is considered essential by the Chamber of Mines, Johannesburg, that something should be done to ensure a permanent supply of water to the mines. Now, fortunately for Johannesburg, not only are the Karoo strata overlying the dolomite interspersed with thick seams of coal, which can be delivered at the mines at eight shillings per ton, but the dolomite overlying the gold-

bearing strata is full of springs. The springs lie between 700 and 1,000 feet below Johannesburg, and from 15 to 30 miles from the Rand. They discharge between them about 70 or 80 cubic feet per second. If half the water of each spring were taken for the mines and the other half left for agriculture the quantity would suffice for the mines. The existing agriculture in the valleys fed by the springs would not, in the end, be allowed to suffer, even in area, because the losses could be compensated by digging suitable channels through the reedy marshes, which are to-day fertile sources of loss, and by gradually making suitable reservoirs for storing the waste water of the springs, and as much of the surface flow of the ground as was considered necessary. The agricultural wealth of the valleys would increase with the future increase of the wealth of the mines, just as in the past it has been more than quadrupled by the presence of the mines themselves.

FRUIT PACKING FOR EXPORT.

Throughout the West Indies, an increasing number of people, year by year, take some part in raising and packing perishable produce for distant markets. All alike, whether interested in oranges, bananas, pine-apples, onions, or sweet potatoes, have the same object, the placing of their produce on the market in a sound condition. It is no easy task to accomplish this off-hand. We must know the exact stage at which each kind of fruit or vegetable must be gathered in order to keep sound during its long journey, and arrive in England or America in the best state. We also have to learn how to treat the produce between picking and packing; the conditions necessary to allow "ripening" to proceed during voyage, and to prevent chilling and rotting. On all these points knowledge has in the past been gained by experience, and the general precautions necessary for the successful export of fruit and vegetables are now fairly well known, although, unfortunately, not always acted upon.

One point the experience of the past has clearly brought out, and that is, the absolute necessity of careful packing. A man may raise the finest oranges or pine-apples in the West Indies, he may gather them at the right moment, and handle them carefully, but, unless they are well packed, his trouble is to a great extent thrown away, for they are practically certain to arrive on the market in poor condition.

At the last agricultural conference the question of regulating the quality of exported fruit was brought forward by the Honourable Sydney Olivier, C.M.G., Colonial Secretary of Jamaica. He pointed out that bad packing was responsible for the disrepute into which some West Indian fruit was falling in the English market. "All the buyers have been frightened off Jamaica oranges and will not touch them on any account." Similarly with regard to pine-apples, His Honour H. Hesketh Bell writes:—"Pines in barrels are a by-word in Covent Garden market."

That the fault lies with the packer and not with the fruit, the recent very successful shipments of oranges, bananas, and pine-apples from Dominica and Barbados sufficiently prove.

The situation is exactly the same with regard to sweet potatoes in the United States. One set of producers save some 50 cents per barrel in labour, &c., in their packing, and, as a result, obtain about 1·00 dol. per barrel less than those who pack carefully.

The question of packing is one demanding the careful attention of every exporter of fruit or vegetables from the West Indies, for if bad methods of packing are persevered in, their produce will fail to gain the confidence of the market and their industry fall to the ground.—*The Agricultural News (Barbados).*

PETROLEUM BRIQUETTES IN FRANCE.

Briquettes made with petroleum have been manufactured in various ways in different countries, notably in Russia, France, and the United States, as a combustible for steam-ships and for certain industries where rapid production of heat is desirable. The advantages of such a substitute for coal are readily apparent—less storage room, complete combustion, &c. It is surprising, says Consul Brunot, of St. Etienne, that petroleum has not been utilised more generally in this form. The objections are that the briquettes injured the boilers after a short time by reason of some chemical action produced by combustion; further, the blocks did not keep their form under the action of the heat, but fell through the fire-box in a liquid state, and the price is said to be two-thirds more than that of coal. A company has recently been formed at St. Etienne for the manufacture of petroleum briquettes which claims to have obviated all the objections except that in regard to price. The advantages of the product are set forth as follows:—The briquette is composed of 97 per cent. of petroleum and 3 per cent of hydro-carbon. The volume being equal, it weighs only half as much as coal, and gives but from 2 to 3 per cent. of residue; it produces no slag; it does "run" when lighted, and keeps its form, like coal; it burns without odour and without smoke; it may be wetted with impunity, losing none of its properties; it consumes without explosion or sparks, and yet with a bright and long flame; it may be kept indefinitely without deterioration. By this process, a degree of saponification is obtained, by which the briquettes are rendered unchangeable even to the extent that if a projectile should enter a ship's bunker filled with this fuel, there would be no danger whatever of explosion, the effect being the same as in the case of ordinary coal. The average heating power is from 12,000 to 14,000 calories, and the briquettes can be employed in any fire-box or in any grate for domestic purposes. The

manufacture of these briquettes is very simple, and requires but little machinery. If necessary, the petroleum contained therein can be recovered with a loss of only 5 to 7 per cent. The same company manufactures what are called mixed briquettes—half coal and half petroleum—but if these are cheaper than the former, they present less advantages from the fact that the density is greater and the heating power is only 9,000 calories. A steamer carrying 8,000 tons of coal would require 3,500 tons of mixed briquettes, and only 2,500 of the pure petroleum briquettes.

ROYAL DANISH PORCELAIN.

The Royal Porcelain Manufactory was established in 1779, at which time the three blue waved lines were adopted as the trade mark; later a crown and the word "Denmark" or "Royal Copenhagen" were added in green. Until the close of the 18th century the manufactory chiefly imitated the works of Meissen, Berlin, and Fürstenberg. From the beginning, according to a Danish review, it produced the blue mussel painted china, so called from the shell which serves as a handle to the covers. The pattern is painted by hand, whereby it obtains the individual stamp, with cobalt colour; it is afterwards glazed and finally burnt. The decoration which is covered by the glaze is absolutely imperishable. This china now includes two qualities of finer make, namely, "lace edge" and half "lace edge." In 1883 the manufactory was established in new premises, and steps were taken to gain new markets. The same underglazing which was applied in the first manufacture of the mussel painted china was continued, but in addition to the blue colour, green and tints of red were included; later on, other less important colours were added. In 1898 the manufactory was enlarged, enabling it to produce half as much again. It has been represented at all of the various exhibitions, and was awarded the Grand Prix de Paris in 1900, and also placed as number two of the competitors. At the Paris Exhibition besides having a wide selection of patterns of porcelain with liquid glaze, the manufactory had also an exhibit of modelled animals. The manufactory has established branch depôts in Paris, London, and New York.

Obituary.

JOHN HUNGERFORD POLLEN, M.A.—Mr. Hungerford Pollen, a member of the Society of long-standing, died at his residence in Pembridge-crescent on Tuesday, the 2nd inst. He was the second son of Richard Pollen, of Rodbourne, Wilts, who was the second son of Sir John Pollen, the first baronet. Born on November 19, 1820, Mr. Hungerford Pollen was educated at Eton and Christchurch, Oxford. He graduated in 1842, and soon afterwards was elected a Fellow of Merton. He studied painting in Rome, and during the tenure of his fellowship he painted the roof of the chapel. In 1857 he co operated with Rossetti and Burne Jones in the decoration of the building of the Union. Mr. Pollen took orders, and after leaving Oxford he went to St. Saviour's, Leeds. After he joined the Roman Catholic Church he was Professor of Fine Arts in the Catholic University founded by Cardinal Newman in Dublin. He was official editor of the "Universal Catalogue of Books on Art," and the "Art Handbooks," published by the Science and Art Department, South Kensington, and for some years acted as private secretary to the Marquis of Ripon. Mr. Pollen was elected a member of the Society of Arts in 1870. He delivered a course of Cantor Lectures in 1885 on "Carving and Furniture," and read papers on "The Present Condition of the Art of Woodcarving in England," "Ornamental Glass," and "Renaissance Woodwork in England," for which last paper he received the Society's silver medal. He was also a member of the committee of the Applied Art Section.

General Notes.

ELLIS'S MUSICAL SCALES.—Mr. A. J. Hipkins has printed, for private circulation, a pamphlet, entitled "Dorian and Phrygian from a non-harmonic point of view," which forms a supplement to the late Mr. Alexander J. Ellis's paper "On the Musical Scales of Various Nations" (see *Journal*, Vol. xxxiii., 485, 1102). Mr. Hipkins expresses his willingness to send a copy to any member of the Society interested in the subject, who will apply to him at 100, Warwick-gardens, Kensington, so far as the edition printed will suffice.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock:—

DECEMBER 17.—"The South Russian Iron Industry." By ARCHIBALD P. HEAD, Mem.Inst.C.E. MR. WILLIAM EGERTON HUBBARD will preside.

Papers for Meetings after Christmas:—

"Industrial Trusts." By PROF. W. SMART, LL.D. SIR ROBERT GIFFEN, K.C.B., LL.D., F.R.S., will preside.

"Oil Lighting by Incandescence." By ARTHUR KITSON.

"The Metric System." By A. SONNENSCHEIN.

"The Cost of Municipal Trading." By DIXON H. DAVIES.

"Stage Costumes and Accessories." By PERCY MACQUOID.

"The Principles of Applied Art." By G. F. BODLEY, R.A.

"Modern Movements in Decorative Art." By CHARLES HOLME.

"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo.

"Three Colour Printing." By HARVEY DALZIEL.

"The Port of London." By Dr. B. W. GINSBURG.

"Tonkin, Yunnan and Burma." By FRED. W. CAREY, late H.B.M.'s Acting-Consul at Szemao, China.

"The Indian Census." By JERVOISE A. BAINES, C.S.I.

"The Province of Sind." By HERBERT M. BIRDWOOD, C.S.I., LL.D.

"Women in Canada." By the COUNTESS of ABERDEEN.

"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., C.I.E.

"The Use of Electrical Energy in Workshops and Factories." By ALFRED C. EBORALL, M I.E.E.

"Methods of Mosaic Construction." By W. L. H. HAMILTON.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

PROF. VIVIAN B. LEWES, "The Future of Coal Gas and Allied Illuminants." Four Lectures.

LECTURE IV.—DECEMBER 15.—Lighting by oil and the advances of the past fifty years—The use of oil in incandescent mantle lighting—Vapour burners and their future—Air gas and its latest developments —The present position and future of acetylene.

JUVENILE LECTURES.

Wednesday afternoons, at Five o'clock:—

Professor EDWARD B. POULTON, M.A., D.Sc., F.R.S., "Means of Defence in the Struggle for Life among Animals."

Lecture I., December 31. Lecture II., January 7.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 15...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. Vivian B. Lewes, "The Future of Coal Gas and Allied Illuminants." (Lecture IV.)

British Architects, 9, Conduit-street, W., 8 p.m. Mr. Arthur J. Evans, "The Palace of Knossos, Crete."

Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. Cato Worsfold, "French Stonehenge."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Henry Norman, "Russia of To-day."

TUESDAY, DEC. 16...Statistical (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 5 p.m. Mr. W. M. Acworth, "Railway Statistics."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Stephen Martin-Leake, "The Rupnaryan-bridge, Bengal-Nagpur Railway."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m.

WEDNESDAY, DEC. 17...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Archibald P. Head, "The South Russian Iron Industry."

Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Mr. C. V. Bellamy, "The Climate of Cyprus." 2. Mr. H. Helm Clayton, "The Eclipse Cyclone of 1900."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. F. R. Dixon-Nuttall and Rev. A. Freeman, "The Genus Diaschiza." 2. A demonstration by Mr. E. R. Turner on "A New Arrangement for taking Photomicrographs in Colours."

Chemical, Burlington-house, W., 5½ p.m. 1. Mr. H. J. H. Fenton, "A Reagent for the Identification of Carbamide and of certain of other Nitrogen Compounds." 2. Messrs. Cain and F. Nicoll, "The Rate of Decomposition of Diazo-compounds." Part II.—Diazo-compounds of the Naphthalene Series. 3. Mr. Walker, "The state of Carbon Dioxide in Aqueous Solution." 4. Mr. J. Walker, "Qualitative Separation of Arsenic, Antimony and Tin." 5. Messrs. J. Walker and W. A. Fyffe, "The Hydrates and Solubility of Barium Acetate." 6. Messrs. J. F. Thorpe and W. J. Young, "The $\gamma\beta$ Dimethylgluteric Acids, and the Separation of Cis and Trans Forms of Substituted Glutaric Acid."

THURSDAY, DEC. 18...Antiquaries, Burlington house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. W Thos. Scott, "Notes on Copepoda from the Faroe Channel." 2. Mr. Alfred A. Walker, "Amphipoda of the 'Southern Cross' Antarctic Expedition." 3. Dr. H. J. Hansen, "The Deep-Sea Isopod, *Anurus branchiatus*, Bedd."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. F. J. Melville, "Postage Stamps with Stories."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. W. B. Esson, "Notes on recent Electrical Designs."

Historical, Clifford's-inn-hall, Fleet-st., E.C., 5 p.m. The Right Rev. F. A. Gasquet, "The Premonstratensian Order in England."

Numismatic, 22, Albemarle-street, W., 7 p.m.

Optical, 22, Hanover-square, W., 8 p.m. Dr C. V. Drysdale, "Some Points in the Design of Optical Instruments."

Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. Conrad Beck, "A New Apparatus for Testing Lenses."

Mining and Metallurgy, in the Rooms of the Geological Society, Burlington-house, W., 8 p.m. 1. Messrs. S J. Truscott and N. Samwell, "Notes on the Ivory Coast, West Africa." 2. Mr. A. Mervyn Smith, "Electric Power at the Kolar Gold Field." 3. Mr. F. J. Stephens, "Note on the occurrence of Asbestos in the N.W. Provinces of India."

FRIDAY, DEC. 19...Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. P. R. Wray, "Electricity Supply from Double Current Generators."

Mechanical Engineers, Storey's-gate. S.W., 8 p.m. Mr. J. N. S. Williams, "Recent Practice in the Design, Construction, and Operation of Raw Cane Sugar Factories in the Hawaiin Islands."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

FOTHERGILL PRIZE.

The Council, acting on the recommendation of the judges appointed by them—Sir William Preece, K.C.B., F.R.S., Mr. Robert Kaye Gray, and Mr. Alexander Siemens—have awarded the prize of fifty pounds, together with a silver medal, offered for an essay on "Existing Laws, By-laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions," to Mr. T. Brice Phillips, Sanitary Inspector to the Uckfield Rural District Council, of 4, Aylesford-terrace, Uckfield, for his essay, bearing the motto, "Fiat Lux."

The Council have also awarded a prize of ten pounds with a bronze medal to Mr. George H. Paul, Lydford, Cyprus-road, Finchley, N., for his essay bearing the motto, "Ariston Metron;" and a similar prize to Mr. W. Craig Henderson, D.Sc., 1, Brick-court, Temple, E.C., for his essay bearing the motto, "Sola Virtus Nobilitat," these two essays being considered to be equal in merit.

They also consider the essay sent in by Captain Arthur W. C. Shean, 18, Finsbury-circus, E.C., bearing the motto "Fuego" to be worthy of honourable mention.

The judges reported that the essays were on the whole of a meritorious character, and, generally, of a high class.

It is proposed that the prize essay should be read as a paper at one of the Ordinary Meetings of the Society.

In all twelve essays were received in response to the offer.

INDIAN SECTION.

Thursday afternoon, December 11, 1902, Earl Percy, M.P., in the chair. The paper read was "Domestic Life in Persia," by Miss Ella C. Sykes.

The paper and report of the discussion will be published in a future number of the *Journal.*

CANTOR LECTURES.

On Monday evening, 15th inst., Professor Vivian B. Lewes delivered the fourth and last lecture of his course on "The Future of Coal Gas and Allied Illuminants."

On the motion of the Chairman, a vote of thanks to the lecturer for his course of lectures was passed.

The first lecture will be published in the next number of the *Journal.*

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, December 31st and January 7th, at 5 o'clock, by Professor Edward B. Poulton, M.A., D.Sc., F.R.S. on the "Means of Defence in the Struggle for Life among Animals."

Each member is entitled to a ticket admitting two children and one adult. As the full number of tickets has not yet been distributed, members applying can still be supplied.

Proceedings of the Society.

FIFTH ORDINARY MEETING.

Wednesday, December 17, 1902; William Egerton Hubbard in the chair.

The following candidates were proposed for election as members of the Society:—

Bale, Hon. Sir Henry, K.C.M.G., K.C., Ingleside, Pietermaritzburg, Natal, South Africa.

Causton, Harry, Clive-street, Tunstall, Stoke-on-Trent, Staffordshire.

Chambers, Walter Ashbridge, 1, Medow-street, Fort, Bombay, India.

FitzSimons, F. W., F.Z.S., The Museum, Pietermaritzburg, Natal, South Africa.

Halse, Sidney Joseph, A.R.I.B.A., 60, Margaret-street, Cavendish-square, W.

Mudaliar, P. Ramanatha, B.A., Manônmani Vilas, Chintadripet, Madras, India.

Pears, Francis, Lanadron Estate, Muar, viâ Singapore, Straits Settlements.

Perkins, Charles Cliftorde, M.I.Mech.E., 6N Bickenhall-mansions, W.

Powell, Edmund, Cambria, Claremont, Cape Town, South Africa.

Sadler, Lieut.-Colonel James Hayes, C.B., H.M. Commissioner for the Uganda Protectorate, Entebbe, Uganda, British East Africa.

Stoneham, Herbert S., 70, Cornhill, E.C.

Tudman, Albert Richard, A.M.I.E.E., Electricity Works, Colwyn Bay, North Wales.

Waddom, Thomas, Knowestone, Gosforth, Newcastle-on-Tyne.

The following candidates were balloted for and duly elected members of the Society:—

Edwards, Reginald William, Brooklands, Church-lane, Aldershot.
Niles, Marston, 140, Nassau-street, New York City, U.S.A.
Saenz de Zumaran, Alfonso, Chargé d'Affaires de l'Uruguay, Legation Office, 104, Victoria-street, Westminster, S.W.
Vigor, Rupert H., 15 and 17, King-street, West India Dock-road, Poplar, E.
Visick, Charles, A.M.I.Mech.E., Messrs. W. Visick and Sons, Basset Works, Devoran, Cornwall.
Wyatt, T. G., North Clifton Plumbing and Engineering Works, Guernsey, Channel Islands.

The paper to be read was—

THE SOUTH RUSSIAN IRON INDUSTRY.

By Archibald P. Head, M.Inst.C.E.

In August, 1901, the author visited the South Russian iron district to report on certain iron, coal, and manganese mines and blast furnaces, and enjoyed exceptional facilities for examining these industries from a metallurgical as well as from a commercial standpoint. The present paper is founded on the result of his investigations.

The production of iron in South Russia has made rapid strides in recent years, and this region is now by far the most important of the eight iron-producing districts in Russia, both European and Asiatic. The following Table shows their relative importance, on the basis of the production of pig iron:—

Production of Pig Iron in Russia.

District.	Tons in 1899.* (Based on 1st half year).	Percentage of total.
South Russia..	1,241,150	47·3
Ural..........	772,926	29·44
Poland	291,588	11·0
Moscow	258,596	9·8
North	31,696	1·2
Finland	25,794	0·97
Siberia........	4,814	0·18
South-West ..	2,946	0·11
Total	2,629,510	100·00

* The figures for 1900 show that while the total annual production only advanced to 2,850,256 tons, the South produced 51·7 per cent. of the total, and the Ural district remained practically stationary.

For comparison:—

	Production in 1899. Tons.
United States............	13,620,703
United Kingdom	9,300,000
Germany	7,900,000

Fig. 1 shows the same facts in graphic form. It will be seen that the Ural district, which is generally supposed to be the great Russian iron centre, has now lost its supremacy. The more rapid progress made by the Southern district is shown by the fact that whereas the increase of production of pig iron in the Urals between 1895 and 1899 was 45 per cent., that of the South was 130 per cent. during the same period.

In the production of finished steel, the South shews a still greater supremacy over all other districts, as follows:—

Production of Finished Steel in Russia.

District.	Tons in 1900.	Percentage of total.
South Russia	843,950	58·64
Ural	181,950	12·63
Poland	203,910	14·14
Moscow	123,620	8·60
North.............	86,280	5·99
Total	1,439,710	100·00

Topography.—Having now established the fact that the Southern iron industry is by far the most important in Russia, the general topography of that district may be considered.

This is shown in Fig. 2, which gives a general view of the section of Russia lying immediately to the north of the Sea of Azov. Most of this district is included in the Government of Ekaterinoslav, the town of that name being the most important of the district and the centre of the iron industry.

The various works, as enumerated in Appendix I., may be said to lie on the Ekaterine Railway, which joins the Krivoy Rog iron mining region in the west, to the Donetz coalfield in the east, the distance being about 260 miles. In some cases the works are situated near the iron ore, carrying their coke and coal long distances. In other cases, and these form the majority, the works are situated on the coalfield, drawing their ore supplies from a distance. In other cases again, the works are between the two, dividing the total distance of 260 miles, over which the raw material must be hauled, between the ore and the coke.

Most of the works own their own mine or mines in the Krivoy Rog district, and collieries or coke ovens in the Donetz coalfield.

Krivoy Rog Iron Ore District.—Fig. 3 (p. 77) shows the Southern and Northern end of the Krivoy Rog iron ore deposits. The town of Krivoy Rog, from which the deposit is named, is situated near the point where the river Saksagan, flowing from the north, joins the river Ingoulets, flowing south. The iron ore deposits lie extended in a long and approximately straight line, chiefly along the right or western banks of the two rivers above mentioned, commencing at a point about 15 miles north of Krivoy Rog, and continuing in an almost uninterrupted series of mines to Nicolo-Koselsk, about 20 miles south of Krivoy Rog. There is also a detached group of mines about 33 miles north of Krivoy Rog, making the total length of the deposit about 53 miles.

The author visited and examined the Skalevatka mines at the extreme southern end of the deposit, and the Kamschatka mine at the extreme northern end, and made a more cursory survey of many of the intermediate mines. (See Figs. 4 and 5, p. 78).

Before the discovery of these deposits, the iron ores of the eastern portion of the Government of Ekaterinslav, and those of the province of the Don Cossacks, and of Kertch in the Crimea, formed the chief sources of supply in

FIG. 1.

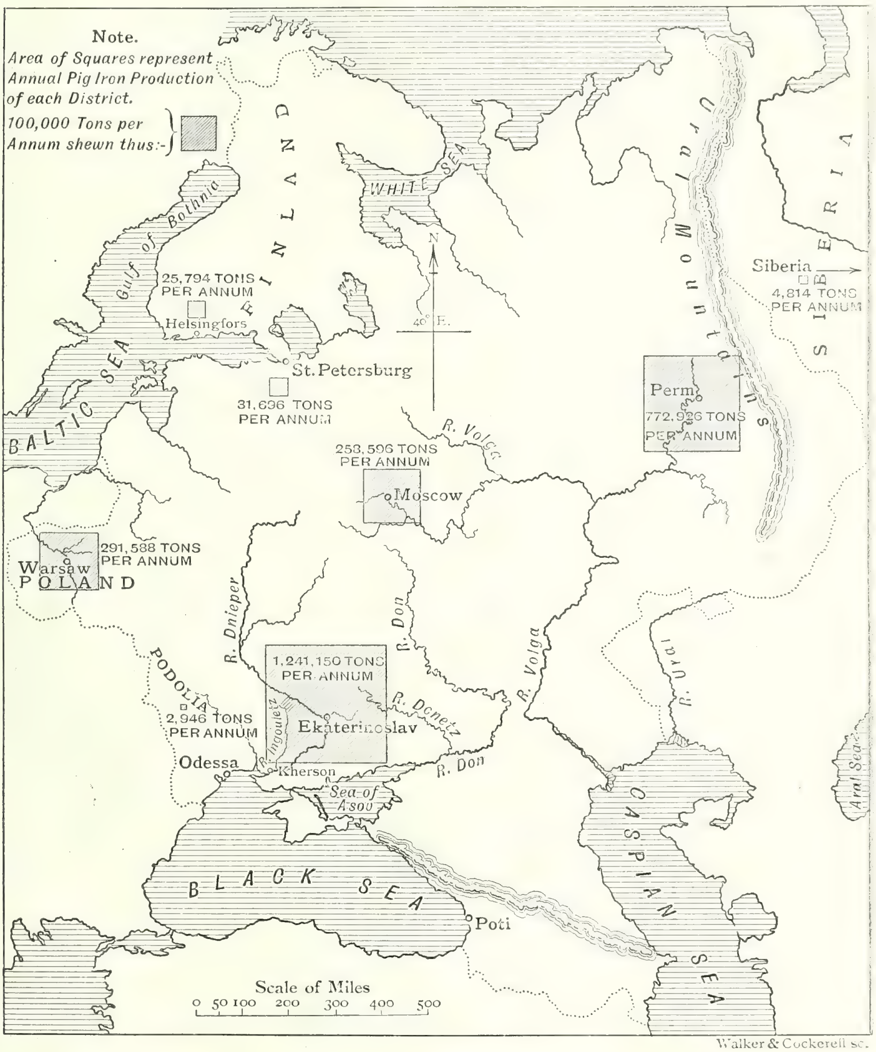


Fig. 2.
SOUTH RUSSIAN IRON DISTRICT.
Natural Scale. 1:2,724,500.
Scale of Miles

the south. The true commencement of the southern iron industry dates from the discovery of the Krivoy Rog deposits, and to the latter it owes its present importance. The chief development occurred between 1892 and 1897, when the output of ore was increased three-fold.

The total number of mines in the Krivoy Rog district was, in 1900, seventy-nine, of which about three-quarters were to the north, and one quarter to the south of Krivoy Rog. According to official figures, the amount of ore obtained in 1900, from such of the mines as were in operation, was 2,753,500 tons, while the

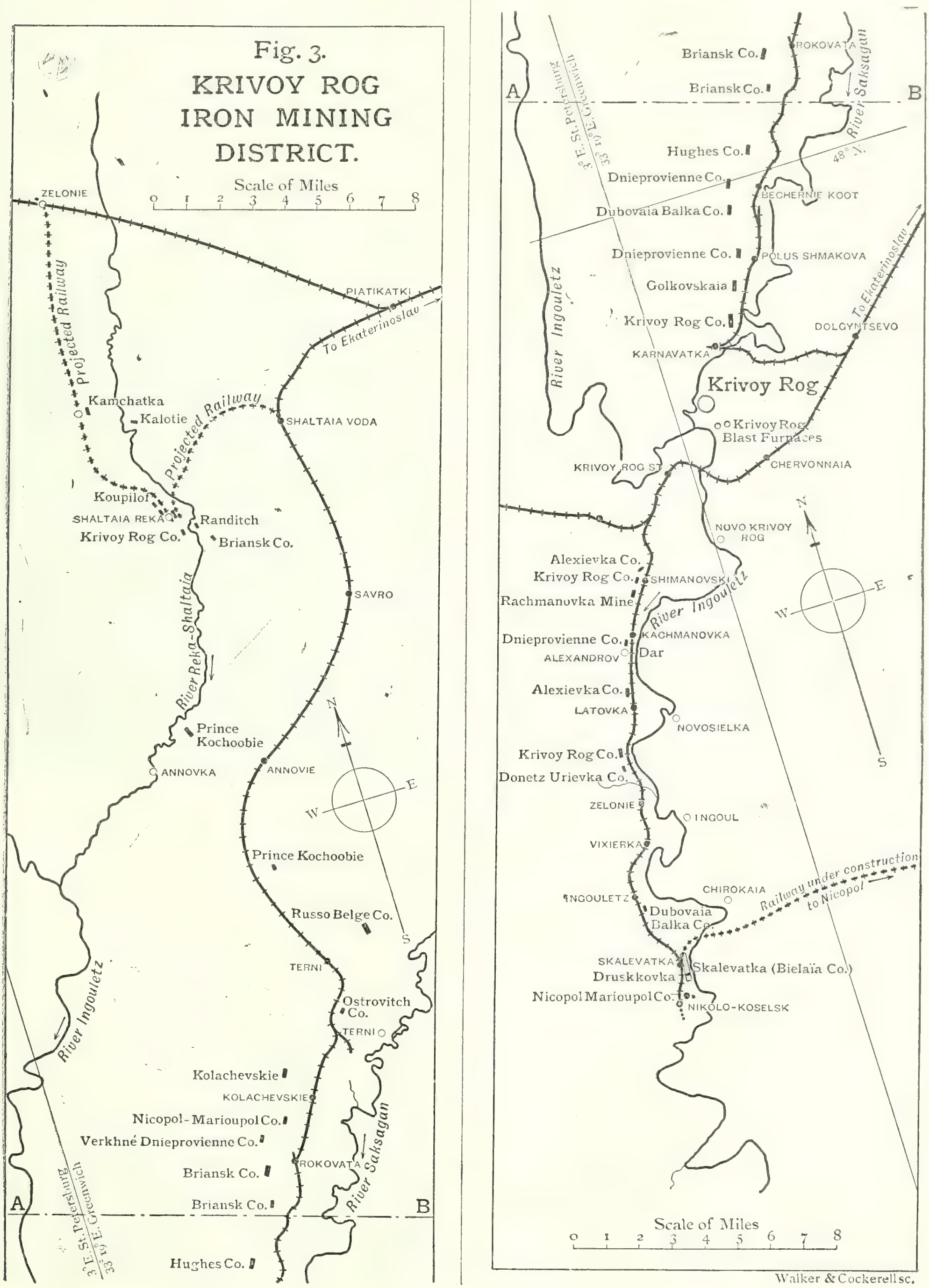
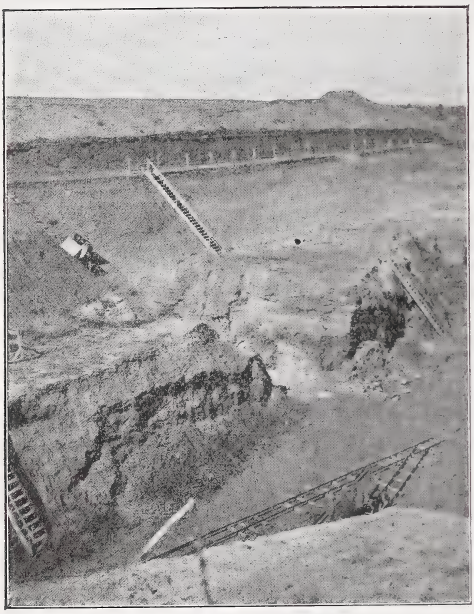


Fig. 3.
KRIVOY ROG IRON MINING DISTRICT.

amount of ore still remaining untouched was estimated at 80,000,000 tons. The stocks of ore ready for sale on July 1st, 1900, amounted to 500,000 tons, and the number of workmen employed was 72,401.

The ore is in general some form of hematite with occasional deposits of magnetite. It occurs as a highly inclined bed, usually in long boat-shaped pockets, tapering at the ends. The various pockets lie approximately north and south, and, so far as local geologists have been able to decide, may be classified as five or six parallel beds, each bed being represented

Fig. 4.



Kalotie Iron Mine (Krivoy Rog District).

by a series of detached elongated pockets, to some extent resembling each other. The hanging and foot walls are of quartzite, which is sometimes also found embedded in the ore in the form of small pockets, but which can be easily separated by hand. The ore contains from 45 to 65 per cent., and sometimes even more, of metallic iron, the sulphur and phosphorus being somewhat variable. The covering is usually clay or sandstone, with limestone immediately below, resting on the top of the ore. The depth of stripping varies from a few feet to about 100 feet, but it is seldom too great for open working. Consequently, most of the Krivoy Rog mines are worked as open quarries, the ore either being carried up long zig-zag inclines by carts and horses, or else drawn in narrow-gauge cars up an inclined railway by a horse-driven drum or a steam engine. When the depth exceeds 200 feet, it is more economical to work underground.

The richer Krivoy Rog ores are sent to distant points, such as the Donetz district and Poland, while the poorer qualities are used locally at the Krivoy Rog Blast Furnaces, or at one or other of the large works lying between Krivoy Rog and Ekaterinoslav. The ore is usually extracted by contractors, who find

Fig. 5.

Shaltaia Reka Iron Mine.
(Krivoy Rog District)

labour, implements, carts, horses, &c. Where the mine is near the surface, such a contract can be made for 3s. 4d. per ton, including delivery at the railway. In a small mine, where pumping is not required, and the mine is shallow enough to dispense with hauling machinery, the contracting system is convenient and economical. In large mines, where steam engines are used for pumping and hauling, and narrow-gauge railways or aerial tramways for transporting the ore to the nearest main line railway, it pays to dispense with the contractor and his somewhat primitive methods, or to restrict his sphere of action to certain well-defined functions. The miners

work ten hours a day, and nightwork is unusual.

In many cases the land is the property of the village communes, and royalty is payable to the peasant proprietors, being generally from 8d. to 1s. per ton. The peasants are prohibited by law from selling their land or from leasing it for more than 30 years. The average cost of mining ore on a moderate scale and delivering to blast furnaces in the Donetz district is about 13s. 1d. per ton, the details being given in Appendix II.

Quality of Ore.—Appendix III. gives two typical analyses of ores from deposits at the extreme southern and northern ends of the Krivoy Rog district, and made for the author by Messrs. Pattinson and Stead from samples selected by him. The southern analysis shows an ore with too high phosphorus for the acid process of steel making, but well adapted for making foundry pig iron. The northern analysis would be suitable for pig iron containing a sufficiently small amount of phosphorus to be classed as Bessemer.

Railway Communication.—The railway facilities for the carriage of ore have recently been much improved. The mines to the north of Krivoy Rog have for some time been served by that section of the Ekaterine Railway between Karnavatka and Shaltaia Voda, about 38 miles long. Previous to June, 1901, all the mines south of Krivoy Rog had no railway nearer than Krivoy Rog itself, which necessitated expensive cart transport over long distance. But in that month a new railway was opened from Krivoy Rog southwards to Nicolo-Koselsk, at the extreme southern end of the deposit.

An alternative route will be provided by another new railway now under construction, which will run from Nicolo-Koselsk *viâ* Nicopol to Alexandrovsk, the highest navigable point on the Dnieper river. The route thence to the iron works of the Donetz district will be either by the existing railway system through Sinelnikova and Debaltzevo, or by a projected new line direct from Alexandrovsk to Debaltzevo, being a continuation of the Nicolo - Koselsk - Alexandrovisk Railway already referred to, and intended to relieve the congestion of traffic on the Ekaterine Railway. New railways are also under construction from Nicolo-Koselsk to Odessa and to Kherson, thus giving an easier access to the sea than now exists.

Donetz Coalfield.—The Donetz Coalfield, which lies at the eastern extremity of the Ekaterine Railway, supplies coal and coke for smelting and metallurgical purposes. It is one of the largest coalfields in Europe, covering an area of nearly 9,000 square miles, and contains almost every variety of coal, comprising gas and cannel coal, caking and coking coal, semi-anthracite, and anthracite. The output of coal in the Donetz district increased from 2·2 million tons in 1888 to 6·68 million tons in 1897. Generally speaking, the soft coals of newer formation lie to the northwest, while the older beds of anthracite lie to the south-east. In one colliery, near Lugansk, visited by the author, both bituminous or steam coal and coking coal are worked, being obtained from neighbouring seams. The steam coal, which represents a fair average of its class, contains 35 per cent. of volatile matter, and 3 to 4 per cent. of ash. This coal is used for steam, locomotive, and gas making purposes. It is unfortunately somewhat friable and subject to disintegration from the weather. As a result the Northern Russian Railways find it difficult to use it, as so much breakage occurs during transit. It is also difficult to build walls of blocks of coal round the stocks, as the weather causes them to crumble. Imported English coal, therefore, still holds its own, especially near the Baltic ports. The coking coal on the above mentioned colliery contains 20 per cent. of volatile matter, and 3 to 7 per cent. of ash.

The coal seams are generally 3 to 4 feet thick, and often inclined at a considerable angle or nearly vertical. In such cases the coal is worked by an "overhead stoping" system. Vertical shafts are sunk, from which run galleries in the direction of the dip, cutting several seams. At each intersection side galleries are run, from which the coal seam is worked upwards in slices of 80 to 100 feet thick. The cost of coal and of coke, of which details are given in Appendix IV., are about 7s. 11d. and 13s. 10d. per ton respectively. The mining methods and appliances used are largely Belgian, as also are the foremen. The coal is mined by an ordinary pick, and each miner can get from two to four tons of coal per 10 hours, according to the thickness of the seam.

There is an almost inexhaustible supply of coal of all qualities in the Donetz region. Mechanical haulage and coal-getting is not usual, owing to the cheapness of labour, and the scarcity of skilled mechanics to maintain and repair machinery. While the physical quality of the coal leaves much to be desired,

the coke is, on the whole, strong and suitable for blast furnaces. Coking coal, containing 20 per cent. of volatile matter and 3 to 7 per cent. of ash, produces coke containing an average of 10·5 per cent. of ash and 1·125 per cent. of sulphur. Coppée coke ovens are largely used in this district, being supplied with modern coal-handling appliances, and giving a yield, or ratio of coke to coal charged, of about 73 per cent. As a rule, the bye-products are not recovered from the gases, which are allowed to burn freely in the air. The ovens are frequently built and financed by the patentee, on a working agreement with the company.

Flux.—No iron district can be considered complete without a supply of flux for mixing with the coke and ore in blast furnaces, and in this respect also, nature has been bountiful to South Russia. There are plentiful deposits of limestone, not only near the Krivoy Rog ore, but along the Ekaterine Railway and in the Donetz coal basin. About half a ton of limestone per ton of pig iron is required to flux the Krivoy Rog ores. Limestone can be obtained in the open market for about 4s. 8d. per ton.

Portland Cement.—An allied industry is the manufacture of Portland cement, which is carried on to a considerable extent. The writer visited an open quarry, in which chalk was obtained at one end and clay at the other, of a quality suitable for making cement. These were conveyed about half a mile and manufactured into Portland cement in a well-equipped and modern factory, having a capacity of 100,000 barrels a year.

Manganese Ore.—Manganese ore, which is essential for the manufacture of spiegeleisen and ferro-manganese, both of which are required for steel making, occurs in South Russia in large quantities. The mining districts in Russia are in three groups, viz. :—(*a*) Caucasus, (*b*) Urals, (*c*) Government of Ekaterinoslav.

(*a*) Caucasus.—The mining area is in the Sharapan region, on the Transcaucasian Railway, the shipping port being Poti, on the Black Sea. From here it is shipped either to foreign countries, or to Marioupol or Nicolaief for Russian consumption. This district is the most important manganese ore producing centre in the world, the output at present being about 4,500,000 tons a year, of which about 10 per cent. is used in South Russia.

(*b*) Urals.—The mines occur in the Governments of Perm and Orenburg, but the production is small and the industry is not important.

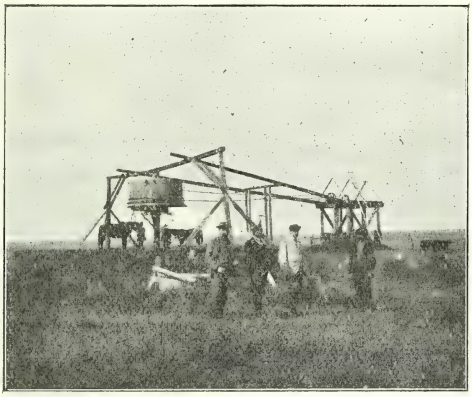
(*c*) Government of Ekaterinoslav. — This group which more nearly concerns the subject of this paper, is situated near the town of Nicopol, on the Dneiper river, and consists of two groups :—The Nicopol group, and the Richishche group, the latter being named after a tributary of the Dnieper river. The Nicopol group contains two principal mines, those of the Nicopol-Marioupol Company and the Briansk Company. The ore requires cleaning, but owing to the scarcity of water, the process has to be performed dry, and the resulting ore contains only about 44 per cent. of manganese. The Richishche group contains only one mine now working, viz., the Horodishche mine, belonging to the Dnieprovienne Company, as well as several others idle or under development. The ore in this group occurs in the form of a practically horizontal bed, about 9 feet thick, of granular peroxide of manganese, or pyrolusite. It is contemporaneous with the over-lying beds, having been deposited with them by aqueous action, and forming the bottom layer on account of its greater weight. It rests on a massive and somewhat uneven bed of granite, which forms the subsoil of all this part of Southern Russia, being sometimes separated therefrom by a thin layer of kaolin or decomposed granite. The manganese ore is in grains between the size of a pea and a nut, and is mixed with coarse sand, but sometimes conglomerated into masses by a hard argillaceous cement and mixed with quartz grains. Frequently a thin layer of manganite or sesquioxide of manganese is found in the lower part of the ore bed. Both the depth and the thickness of the bed are somewhat irregular.

The manganese ore is easily separated from the sand by washing. It is soft enough to be extracted by pick and shovel, one miner getting four cubic yards per twelve hours, weighing about 7¼ tons. The roof is green clay, and the floor is granite or kaolin. The roof-boards are supported by timber frames spaced about two feet apart. The vertical shafts usual in the district are seven feet square, well timbered, and divided into four compartments, two being used for cages, one ascending while the other descends, and the other two for pumping by means of ascending and descending buckets which are filled below by hand. Such a shaft is worked by two "barabans" or drums, each

worked by two horses. (Fig. 6.) In case of a small output, one baraban would suffice, pumping being done during intervals when no ore isbeing raised. With such an appliance 50 buckets of water per hour can be raised, each containing 30 gallons, equal to 1,500 gallons per hour. This is a surprising performance considering the primitive nature of the implements.

The Richische ore is hardly developed, but is likely to play an important part, and to be one of the chief centres of production in South Russia. It corresponds, generally speaking, with Caucasian ore, and would very well take

FIG. 6.



"BARABAN" OR WINDING DRUM AT IVANOVKA MANGANESE MINE.

its place in the manufacture of ferro-manganese and spiegeleisen. Comparing it with foreign ores, it is superior in manganese contents to New Brunswick ore, but inferior to Brazilian and Spanish ores. The analyses of different Russian and foreign manganese ores are given in Appendix V. The details of the cost of raising and washing Richische ore are given in Appendix VI.

The present outlets for the Nicopol and Richishche ores are :—

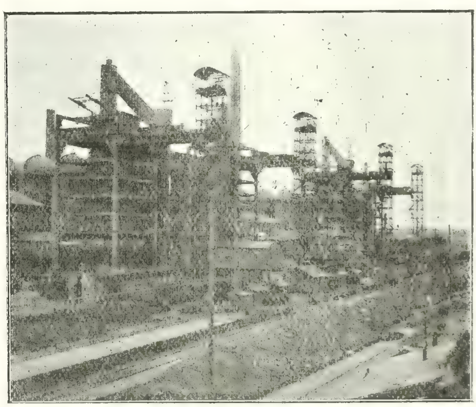
1. Down the river Dnieper in barges to Kherson for shipment abroad.

2. Up the Dnieper in barges to Alexandrovsk, the head of navigation, where it is put on the railway and despatched to the various Russian centres of consumption, chiefly the blast furnaces situated along the Ekaterine Railway.

The railway now under construction from Nicolo-Koselsk to Alexandrovsk *viâ* Nicopol, which is expected to be running in a year or two, will pass through the Richische group, and will afford a much cheaper carriage to Alexandrovsk than the present system of barges which yield high profits to the contractors, and will enable transshipping at Alexandrovsk to be dispensed with.

Iron and Steel Works.—Having now described the raw materials, some mention may be made of the blast furnaces and steel works, where the finished article is produced. Appendix I gives a list of the 18 chief iron and steel works in the South, together with various particulars as to capital and nationality. From column 6, it will be noticed that most of these works have been built since 1892, and are therefore quite modern. Column 4 shows that Belgian capital largely preponderates. Although the first works in this district (the New Russia Company) was started in 1869 by an Englishman, Mr. Hughes, very little English capital has flowed in the same direction. It is different with Belgian capital. Since the establishment of the first Belgian company, the Dnieprovienne, or South Russian Company (associated with Messrs. Cockerill, of Seraing, Belgium), there has been a constant influx of Belgian capital. Out of the most important works enumerated, at least eight are partially or entirely Belgian capital, while out of the total number ot 55 blast furnaces, 21 are Belgian.

FIG. 7.



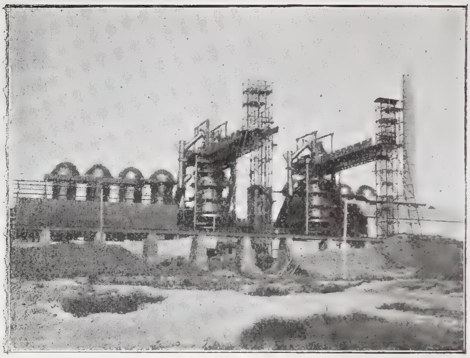
DONETZ-URIEVKA BLAST FURNACES.

The author personally visited five of these works, viz.:—Briansk, Donetz-Urievka (Fig. 7), Gdantsevski, Almaznaia (Fig. 8), and Bielaia (Fig. 9), and was much struck by the good, substantial, and well constructed nature of the work. Generally speaking, the structural portions of the works have been built in Russia,

and the machinery in Belgium, Germany, or France, or to a small extent in England and America.

There is, perhaps, an absence of labour-saving appliances in the blast furnaces, notably in the handling of materials between

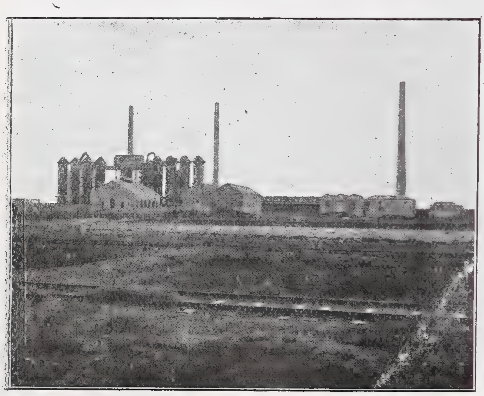
Fig. 8.



Almaznaia Blast Furnaces.

the stock piles and the furnace top. But it must be remembered that Russia is different from Western Europe and America, in the scarcity of skilled mechanics for the maintenance of machinery. Mechanical instinct is not a conspicuous quality among Russians, and the care and foresight exercised by those

Fig. 9.



Bielaia Blast Furnaces.

in charge of machinery is too often regulated solely by the amount of supervision and discipline to which they are subjected. Consequently there is not only a great liability for machinery to go wrong, but great difficulty in repairing it. If to this be added the cheapness of manual labour, there are sufficient reasons for the avoidance as far as possible of all complicated machinery. Generally speaking, a proper mean course has been followed between too much mechanism on the one hand and too wasteful an expenditure of labour on the other hand. After making due allowance for these conditions, the design and workmanship of some of the most modern blast furnaces and accessory appliances leaves little to be desired, and bears comparison with some of the best plants in Europe. The *personnel* are as a rule of the nationality of the owners. Thus in works of Belgian or French capital the director and departmental managers are Belgians or Frenchmen respectively. In Russian works, on the other hand, positions of responsibility are largely occupied by Poles. The workmen are in all cases Russian.

It will be seen that of the eighteen important works in South Russia enumerated in Appendix I, all make pig iron, in a total of 55 blast furnaces, and 11 are steel makers in addition. The works are not concentrated in manufacturing centres, but scattered along the Ekaterine Railway. The whole country is what is known as Steppes, viz., extensive undulating plains, entirely treeless, except by the edges of streams and rivers. Every eminence is crowned by a tumulus, said to have been erected in olden times, either to repel the Tartar invasions or as a burial place for chiefs. The scattered nature of the works and the comparative scantiness of population, as well as the want of enterprise of private builders, makes it necessary for each company, whether mining or metallurgical, to erect colonies for their workpeople, which generally consist of comfortable houses, varying in accommodation from the eight-roomed house, containing four unmarried men per room, to the sumptuous mansion of the director. (Fig. 10.) The rainfall is small, being about 11 inches per annum, due to the treelessness of the land. This necessitates elaborate and expensive arrangements for water supply at most works. At one blast furnace plant visited by the author, an artificial lake has been made, 97 acres in area, holding 143 million gallons of water, and situated 200 feet below the blast furnaces to which water is pumped in two stages by electrically driven pumps.

Blast Furnaces.—Fig. 11 gives a half profile of a typical modern blast furnace in the Donetz district, such as would be suitable for

the production of Bessemer or foundry pig iron, or, by the addition of manganese ore, of spiegeleisen, containing 20 per cent., and ferro-manganese, containing 80 per cent., of manganese. The furnace would have a productive capacity alternatively of:—

Pig iron..	150 tons	per	24 hours.
Spiegeleisen	100 ,,	,,	24 ,,
Ferro-manganese ..	70 ,,	,,	24 ,,

The cost of manufacture and profits derived from these three varieties of pig iron are given in detail in Appendix VII.

Import Duties.—There is an import duty into Russia on ordinary pig iron by way of Black Sea ports of £2 19s. 5d. per ton, which is sufficient to keep out foreign competition. An excise duty of 2s. per ton of Russian-made pig iron was abolished by the Government in

FIG. 10.

COLONY AT BIELAIA COLLIERY.

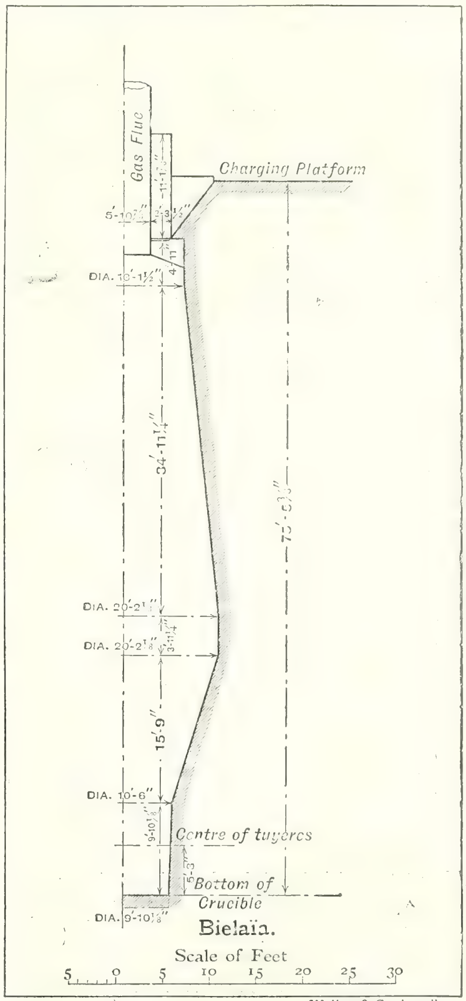
1901, in order to afford some relief to the harassed trade. On account of the heavy import duties pig iron has been imported in but small and decreasing quantities, as follows:—1900, 51,000 tons; 1901, 29,700 tons; 1902, at the rate of 14,520 tons.

The import duty on ferro-manganese and spiegeleisen is £4 19s. per ton, which is sufficient to keep out English-made spiegeleisen, but not sufficient to keep out English-made ferro-manganese, which latter can be sold in South Russia at about £2 per ton below market price, and which is sent regularly from England by way of Black Sea ports at the rate of about 4,250 tons per annum. At the present time, spiegeleisen and ferro-manganese are being made in Russia at five of the works enumerated in Appendix I. The import duties on finished steel products are as follows:—

Steel ingots and plates, £5 18s. per ton; merchant iron, £5 18s. per ton; steel sheets, £8 9s. to £9 18s. per ton.

Government Control.—The Government exercises a very real and somewhat paternal control over the mining companies for the protection of the workpeople, employing an army of officials for the purpose. All com-

FIG. 11.



Walker & Cockerell sc.

TYPICAL SECTION OF BLAST FURNACE.

panies are obliged to supply a Government mining engineer, and are subject to periodical visits by Government inspectors. The companies are obliged to provide proper accommodation for the operatives in the way of houses, hospitals, churches, &c., and the slightest accident resulting in injury to any workman is the subject of Government inquiry. The employers appear to live in dread of

accidents, on account of the troublesome investigations which invariably follow.

Steel Works.—The eleven steel works in South Russia are, as a rule, well equipped with modern machinery. Both the open hearth and Bessemer processes are used for conversion of pig iron into steel. The finished product may be classified as follows:—

	Per cent. of total steel production.
Railway materials (rails, fish plates, tyres and axles)	47·5
Merchant bars, sheets, columns	37·2
Miscellaneous	15·3
	100·0

The present market prices of finished steel products are:—Rails, £8 5s. per ton; rolled joists, £5 15s. 6d. per ton; merchant iron, £8 5s.

Railways.—The abnormally large proportion of railway materials indicates that railway construction absorbs about half the steel production of the south. This is due to the fact that Russia has been, and is still, going through a period of great railway construction, entered upon with a view of developing the resources of her empire, both European and Asiatic. The new mileage opened within the last few years is as follows:—

RAILWAY CONSTRUCTION.

Year.	Opened for traffic.	Existing railway doubled.
	Miles.	Miles.
1898	1,897	205
1899	3,296	160
1900 (1st half)	543	17

About two-thirds of the Russian railways are owned by Government and one-third by private companies as follows:—

OWNERSHIP OF RAILWAYS.

	Government railways.	Private companies.	Total.
	Miles.	Miles.	Miles.
In full operation	21,697	10,118	31,815
In partial operation	1,014	585	1,599
Under construction	1,110	3,394	4,504
Authorised to be built	469	1,557	2,026
	24,290	15,654	39,944

Since 1899 the Russian Government has gradually bought up private railways, and amalgamated into a few large companies those not so bought up. It has thus got rid of large liabilities for guaranteed dividends, and has turned an annual loss into a profit. Railway concessions are no longer granted on the easy terms which were once obtained.

Owing to the relatively small amount of private enterprise and capital in Russia, the general demand for finished steel and iron products for industrial purposes is small, while exports to foreign countries are negligible. The iron and steel industries, therefore, look to the Government as their chief customer, and are dependent principally on orders from it for railway materials. About 40 per cent. of all the free pig iron (*i.e.*, not sold as finished steel) made in the south is purchased by the Government. The prospects of these industries thus depend largely on the programme of railway construction being carried out by the Government at the time, which in turn depends on the funds at its disposal for this purpose. The Government, on the other hand, has fostered and to a great extent brought into existence the southern iron industries by heavy import duties and by distribution of orders. The general demand for steel from the public has not grown apace with the productive capacity of the works, and, indeed, increases very slowly, while the Government requirements have, until 1900, increased very rapidly. The result is that the south is practically dependent on one large customer, viz., the Government.

Trade Depression.—As is well known, Russia has been for the last two or three years passing through a grave commercial crisis which seriously effects all industries, and notably the southern iron industries.

After an unusually active year of railway construction in 1899, the Government, presumably on account of insufficient means, suddenly stopped or almost stopped further expenditure thereon in 1900, while orders for railway building materials underwent a great and sudden decrease, with results which were most keenly felt by the Southern iron industry.

The price of foundry pig iron, which in 1899 had been about £5 5s. per ton, rapidly declined until March and April 1901, when it touched £3 per ton, since which it has recovered somewhat. The cause of the scarcity of money in the State coffers has been variously assigned to the stringency of the money market caused by the Trans-

vaal war, the too rapid industrial development in Russia, the Chinese troubles, the German financial panic, and the recurrent bad harvests in Russia. Probably each one has contributed to the result, but whatever the cause, it seems clear that if sufficient capital flowed into Russia, by means of a foreign loan or otherwise, to enable the railway programme to be recommenced, a large proportion of money so spent would flow to the Southern iron industry, and would bring to it a renewal of prosperity which would probably last for some years. At present the revival awaits this influx of capital.

From the most accurate information which the author was able to obtain, the following railways have actually been decided upon by the Government, some or all of which will probably be commenced as soon as the financial situation admits of it.

1. Trans-Siberian Railway, completion.

2. Trans-Siberian Railway, completion of relaying with heavier rails.

3. St. Petersburg to Odessa, direct line.

4. St. Petersburg to Viatka.

5. Moscow to Kazan and Kishtimsk.

6. Orenburg to Tashkend.

7. Odessa to Donetz Coalfield.

8. Krivoy Rog ore region to Donetz Coalfield.

9. Kief to Kovel.

The total estimated cost of above is about £66,000,000.

The crisis in the coal industry is, perhaps, more acute even than in the iron and steel industries, owing to the added effects of overproduction, and consequent increase of stocks.

Owing to the extensive and almost reckless manner in which Belgian capital has been invested in South Russia, the former country has suffered very heavily from the present crisis. Belgium being a small but rich country, with much greater wealth than can be profitably invested at home, has been a large investor in the South of Russia, which, thanks to the high profits made in former years, seems to have exercised a peculiar fascination for its financiers. It must be remembered, however, that much so-called Belgian capital is really French capital, companies being formed therewith in Brussels owing to the somewhat laxer regulations there existent.

Recent quotations from the Brussels Bourse of Russian securities show that steel works debentures average 73 per cent. of par value, and ordinary shares 30 per cent.

The Russian Government is using every endeavour to introduce foreign capital, and especially English and American, and for this purpose makes copious publications in the English language, dealing with the industrial possibilities of Russia.

The present situation, however, contains some encouraging features. Signs are not wanting that public confidence is being restored in Russia, and prices have already shown a tendency to increase and inquiries to become more numerous. Again, the trying period through which the iron industries are passing, doubtless has done, and will do, much to teach the salutary lesson of economy of management, to which too little attention was paid during the preceding prosperous years. Cost of production in general, and in particular that item with the comprehensive title of "General Expenses," has, under the stress of stern necessity, undergone sensible reduction. Superfluous officials have been discharged and numerous leaks stopped up, with the result that in one case that came under the author's notice a company which during the prosperous times found it difficult profitably to sell steel for £10 per ton, make it pay, after the introduction of such economies, with the price reduced to £8 per ton.

Coinage.—Again the coinage of the country has during the past few years been placed on a gold basis. The amount of gold coins in circulation has increased enormously, while the use of paper money, except of large denomination, has practically ceased. This has tended to make the rate of exchange fixed, and has obviated the disadvantages and uncertainties of fluctuating values. Thus, whereas between 1877 and 1896 the value of the rouble varied from 1s. 7d. to 2s. 9d., since the reform of the coinage it has been practically fixed at 2s. 1½d. The Emperor's Rescript (see Appendix VIII.) will show that the value of sound currency is fully appreciated by the Government.

In Russia, where money is scarcer than in Western Europe, it is doubly desirable to have ample working capital for operating iron and steel works. Long credit is the rule, three months being usually expected by customers. If three months' bills are received from debtors and discounted at banks, a high rate of discount is charged, and it is, therefore, economical to have sufficient working capital to render such discounting unnecessary. This can be set off to some extent by demanding three months' credit from those who supply the raw materials, but the same reasons make

this undesirable. On the other hand, ready cash must always be found for wages and railway charges. The interest paid by banks on deposits is usually 3½ per cent.

Labour.—The native labourers in Russia are cheap, patient, and obedient, but they are less energetic and efficient than the more highly paid workmen of Western Europe, which tends to counterbalance the advantage of cheapness. They are also lacking in mechanical instinct and initiative and are somewhat servile, as might be expected from a people liberated from serfdom only 40 years ago. Education is, from a Western point of view, somewhat primitive, and the village commune system, involving a peasant ownership of land, by discouraging a peasant from moving about, tends to narrow his ideas and prevent his mental development.

Russian villages are sometimes of great size, one called Tomatovka, passed through by the author, being no less than 10 miles long, and rather in the nature of a town than a village. The houses are, however, spread out evenly, each with its own garden, and not, as would be the case with a similar town in England, crowded together in the centre. Each peasant owns, in addition to the garden attached to his house, a share of the common land in the village, the amount per peasant varying from 8 to 27 acres. If he leaves the village and goes to another, he resigns his share of the land, while he is unlikely to be admitted to equal privileges in his new home. He must, therefore, either stay where he is, or emigrate, for which an official permit is required, or go to the large towns, where he is handicapped by his lack of education. To add to his troubles, while the amount of land available has not increased, the number of peasants is increasing, so that each man's share has become smaller. The village commune system, which was established to ensure the peasant against want, is not by any means universally successful in its working.

In former years the Russian peasant was very drunken, and often after he had spent all his money, would pledge his future crops or labour to the publican. After failing to remove these abuses by numerous laws, the Government took the bold step of taking over the manufacture and sale of spirits, which was accomplished between 1895 and 1898. The result was that the consumption of spirits per head, which in 1867 was 1·66 gallons, fell in 1897, even before the reform was completed, to 0·93 gallons per head. The corresponding figures for the United Kingdom and United States are 1·03 and 1·01 respectively.

The greatest benefit that could befall the Russian iron industry would be the growing up of a steady public demand for iron and steel, which would make the Government orders of secondary importance. Russia would then be able to make the most of her marvellous natural mineral resources and cheap labour, and the iron industry would become a great source of national wealth to a country which is at present too purely agricultural. So long as the importance of agriculture is relatively overwhelming, so long will the recurrent bad harvests mean grave financial and political embarrassment to the Government. The growth of public demand for iron and steel is, however, a thing of the future. It must be remembered that the old-time division of Russian society into two classes, *i.e.*, nobles and peasants, still obtains to some extent, 80 per cent. of the population being peasants, while the middle classes, which in the Western nations comprise the enterprise and virility of the community, are in Russia only 9 per cent. of the total, and are largely confined to the cities.

For centuries Russia has looked abroad for, and has welcomed to her shores, men of energy and brains, to initiate and carry on the enterprise and manufactures, which in other countries would spring up naturally from within. This is testified to by the fact that so many Russians in leading positions have non-Russian names.

Railway Rates.—The system of railway rates in Russia is worthy of imitation by the rest of Europe; it is a modified Hungarian zone system, and was introduced about 1895. It is based on the logical principle widely recognised in commerce, of giving a reduction for quantity. Both for goods and passengers the mileage rate varies inversely with the total distance. Thus to convey iron ore from the Krivoy Rog Mines to the iron works in the Donetz district, a distance of 260 miles, costs only 0·23 pence per ton-mile, while for short distances up to 66 miles, the rate is 0·316 pence per ton-mile. In the passenger tariff, the rates are still made in favour of the long journey, with the result that since the new system was introduced, the passenger traffic has increased largely.

Conclusion. — In conclusion, the South Russian iron industry cannot, in the opinion of the author, be considered at present as other than an artificial one, depending as it

does on the high tariffs to keep out foreign competition, and to a large extent on Government activity in railway construction for the demand. Both are unnatural conditions; and though a protective policy is often of long duration, and, as in the United States, not inconsistent with great national prosperity, the single customer condition, involving a demand varying with the resources of the Government for the time being, is somewhat hazardous.

Until the check received in 1900, the growth of Russian manufacturing industries, *i.e.*, other than agriculture, was remarkable, the turnover increasing from £54,000,000 in 1887 to £181,000,000 in 1897. The author refrains from dogmatising as to whether this is because of or in spite of protection.

Although the South Russian district is now very much depressed, it has had periods of great prosperity, and will doubtless have them again. The market for its iron and steel products is, however, likely to be purely internal for some time to come, and in the author's opinion the time when Russia will compete with other countries for the neutral markets of the world, is as yet far distant.

[The thanks of the author are due to the following gentlemen for kindly furnishing information and data:—Messrs. C. Foniakoff, E. Durrant, J. M. de Zoltynski, E. Carez, V. Tahon, B. de Szyszkowski, F. C. Moorwood, and F. Taylor, of the New Russia Company.]

APPENDIX I.—IRON AND STEEL WORKS IN SOUTHERN RUSSIA.

Name of Works.	Where.	Ref. No. Plans.	Source of Capital.	Paid up Capital.	Date of Starting.	Products.	No. of Blast Furnaces.	Production during 1900. Pig Iron Tons.	Production during 1900. Finished Iron and Steel Tons.	Total Tons.	Average No. of Workmen Employed.
Column 1	2	3	4	5	6	7	8	9	10	11	12
Hughes, or New Russia Co.	Hughesofka	1	English	£ 900,000	1869	Pig iron and steel	7	267,820	159,030	426,850	8,319
Dnieprovienne, or S. Russian Co. ...	Kamenskoie	2	Belgian & Russian	764,440	1889	do.	5	209,980	170,580	380,560	6,339
Briansk Metallurgical Co.	Ekaterinoslav	3	Russian	1,701,005	1887	do.	5	145,780	107,790	253,570	7,068
Russo-Belge Metallurgical Co.........	Volintsevo	4	Russo-Belgian	1,579,296	1895	do.	3	150,150	122,255	272,405	2,713
Donetz - Urievka Metallurgical Co.	Urievka	5	Russo-German	845,883	1895	do.	5	109,510	31,006	140,516	3,630
Drushkova, or Donetz Iron and Steel Co.	Drushkova	6	French	702,810	1894	do.	3	94,770	79,620	174,390	2,411
Taganrog Metallurgical Co.........	Taganrog	7	Belgian	1,189,522	1895	do.	3	79,148	62,356	141,504	3,166
Nicopol - Marioupol Mining and Metallurgical Co.	Marioupol	8	German and Russian	789,684	1896	do.	2	76,770	37,410	114,180	1,769
Pastoukof, or Soulinskie Works	Souline	9	Private	...	1869	do.	3	38,738	25,284	64,022	3,004
Russian "Providence" Works ..	Marioupol	10	Belgian	1,784,189	1898	do.	3	72,335	47,135	119,470	1,972
Makievskaia Works	Makievskie	11	...	...	...	do.	2	47,080	16,664	63,744	1,259
Gdantsevski, or Krivoy Rog Iron Mining Co.	Krivoy Rog	12	French	...	1892	Pig Iron	3	52,038	...	52,038	330
Olkovaia Iron Smelting Co.	Ouspensk	13	Belgian	297,365	1896	do.	2	76,277	...	76,277	450
Krematorskova Metallurgical Works	...	14	...	...	...	do.	2	15,059	...	15,059	298
Almaznaia Colliery Co.	Almaznaia	15	Belgian	...	1900	do.	2	14,688	...	14,688	176
Kertch Metallurgical Works	Kertch	16	...	...	...	do.	2	25,059	...	25,059	2,274
Verkhne Dnieprovienne Works......	Ekaterinoslav	17	Belgian	515,432	...	do.	1	...	...	...	...
Bielaia Blast-Furnace Co.	Bielaia	18	Belgian	396,486	New	do.	2	...	...	...	...
						Totals ...	55	1,475,202*	859,130*	2,334,332	

* Later corresponding figures are as follows:—Pig Iron—1901, 1,482,000 tons; 1902 (rate of), 1,457,000 tons. Iron and Steel—1901, 984,000 tons; 1902 (rate of), 894,000 tons.

Appendix II.—Cost of Krivoy Rog Ore.

	per ton. s.	d.
Extraction and delivery to railway by contract	3	4
Opening ground, general charges, &c.	1	3½
Royalty	0	8
Railway carriage to blast furnace	7	9½
Total	13	1

Appendix III.—Analyses of Krivoy Rog Ore.

	Southern Deposits. Per cent.	Northern Deposits. Per cent.
Iron	57·95	63·55
Phosphorus	0·095	0·032
Alumina	2·484	1·567
Lime	trace	trace
Silica	8·150	4·40
Combined water	6·450	3·200
Moisture	0·67	6·35
Character of ore	Brown Hematite.	Red Hematite.

Appendix IV.—Cost of Coal and Coke.

	Per ton of coal. s.	d.
Getting	3	11½
Timber	1	7
Surface expenses		4
Repairs		4
Transport to loading place		1½
Grading		1½
General expenses	1	5½
	7	11
To this must be added the cost of coking	2	2
Making a total per ton of coal of	10	1
Or per ton of saleable coke of	13	10

The market value of coke is about 17s. 9d.

Appendix V.—Analyses of Manganese Ores.

	Manganese.	Phosphorous.	Silica.
Russian—			
Richische ore	52·63	0·127	7·2
Nicopol ore	40·45	0·23	..
Caucasus ore	51·15	0·153	about 10
Foreign—			
Spanish (Asturiana)	58·35	0·01	0·90
New Brunswick (Wad ore)	45·80	0·05	5·36
Brazil	55·02	0·021	1·27

The limits allowed in manganese ores are 0·18 per cent. of phosphorus, and 8 per cent. of water, with a fine of 4d. per ton per 1 per cent. of water above 8 per cent. The price obtainable for ore is 8d. per ton per 1 per cent. of manganese up to 45 per cent. and 1s. 4d. per ton per 1 per cent. over 45 per cent., which would place a value on Richische ore of the above analysis of £2 per ton delivered at blast furnaces in the Donetz district.

Appendix VI. — Cost of Richische Manganese Ore.

	Per ton of washed saleable ore. s.	d.
Mining	2	7½
Timbering	2	7½
Hoisting, repairs, pumping	1	0
Transport to washery	0	3
Sundries and general expenses	1	8
Royalty	1	8
Government tax	0	8
Washing	8	7
Total	19	1

Appendix VII.

Cost of Foundry Pig Iron.

	Per ton of Pig Iron. s.	d.
Iron ore, 1⅔ tons	22	4
Coke, 0·95 tons	21	4
Flux, ½ ton	1	4
Labour, general expenses, &c.	10	0
Total	55	0

Taking the market value at the present exceptionally low figure of 63s. at the time of the author's visit, there is a profit of 8s. per ton. In 1899 the market value was 106s.

Cost of Spiegeleisen.

	Per ton of Spiegeleisen. s.	d.
Iron ore, 1¼ tons	19	0
Manganese ore, 0·6 tons	23	9
Coke, 1·4 tons	31	6
Flux, 1 ton	2	8
Labour, general expenses, &c.	17	2
Total	94	1

Taking the market value of spiegeleisen at £6 5s. 6d., this yields a profit of 31s. 5d. per ton.

Cost of Ferro-Manganese.

	Per ton of Ferro-Manganese. £	s.	d.
Iron ore, ⅛ ton	0	1	11
Manganese ore, 2½ tons	4	19	0
Coke, 2½ tons	2	16	2
Flux, 1 ton	0	2	8
Labour, general expenses, &c.	0	19	10
Total	8	19	7

Taking the market value of ferro-manganese at the exceptionally low figure of £16 10s., this yields a profit of £7 10s. 5d. per ton.

APPENDIX VIII.

IMPERIAL RESCRIPT FROM THE EMPEROR OF RUSSIA TO M. WITTE, MINISTER OF FINANCE.

Sergei Julievitch, in fulfilment of my order, duly applied for by you, the Financial Committee discussed the present state of the money market in connection with the communication on this subject made by the Ministry of Finance, and, after careful examination, presented to me the following unanimous conclusions:—

"I. Our money market has of late been greatly influenced by a combination of unfavourable circumstances, the principal being the universal tightness in the money market, increased by the present war between England and the Transvaal. The position has been further complicated by our bad harvests of late years, and the consequent unfavourable balance of payment, and likewise by the unusually rapid growth of our industries during the past few years. Although in itself this industrial development is advantageous to the country, yet under existing conditions, it considerably increases the tightness in the money market.

"II. Of course, the concurrence of such extremely unfavourable conditions cannot but cause some embarrassment in our money market, but the embarrassment would be much greater, were the country not in a position to withstand it by a well-organised monetary system. Our financial policy must therefore be directed towards the preservation of the stability of the currency—a stability which is one of the most important conditions for the proper development of State and national economy.

"III. The present state of affairs does not call for any universal extraordinary measures, while the particular measures, taken by the Ministry of Finance and the State Bank for the purpose of tranquilising the money market and supporting certain respectable firms, should, if necessary, be continued, without overstepping the limits of the regulation of existing and firmly established relations.

"IV. The suggestions of the Minister of Finance with regard to the necessity of revising the antiquated laws affecting the Bourse and Joint Stock Companies, are decidedly opportune."

Approving of the Financial Committee's conclusions which endorse the expedience of the measures taken by you, I feel assured that in the present temporarily embarrassed state of affairs, you successfully guard the interests both of State and national economy.

This is guaranteed by the enlightened experience, untiring energy, and skill which have always distinguished your management of the financial department, and which have won my confidence in you.

I remain ever favourably disposed to you,

And sincerely grateful, NICHOLAS.

Given at Zarskoe Selo, December 8 (20), 1899.

DISCUSSION.

Professor C. LE NEVE FOSTER, F.R.S., said that he had been for some time in Russia during the past year, and he had listened to the paper with great interest. In speaking of the iron deposits in the Krivoy Rog district Mr. Head had said they were "boat-shaped." For his own part he thought the word lenticular was more appropriate. He was sorry that the iron ore deposits of Kertch were not mentioned by the author. He thought that those deposits might be larger than those at Krivoy Rog. With regard to the coal in the Donetz basin, Mr. Head said it was friable and suffered from the weather. Now, was that due to frost, or was it found to be the same at other periods of the year when there were no frosts? Then was he accurate in his remarks with regard to the percentage of ash in the coke when he said that the percentage was 10 while the coal used only showed from 3 to 7 per cent. Seeing that 73 per cent. of coke was got from the coal it seemed to him that the percentage of ash ought not to be so large as was mentioned. Mr. Head had given a very good illustration of a very large Portland-cement factory, thoroughly up-to-date. Would he explain whether the Russians were using any dust-preventing apparatus? One great fault in this country was the terrible dustiness in connection with cement factories. In Germany he had seen certain appliances used for keeping down the dust. He had hoped to hear something about the wonderful manganese deposits in the Southern Caucasus. With reference to the manganese described in the Ekaterinoslav, Mr. Head stated that owing to the absence of water the mineral was treated dry. Then later on he said it was washed. He could not reconcile the two statements. The views of the pit shafts were interesting, but he thought that shafts seven feet square, divided into four compartments, two of which were used for cages, must be exceedingly small. The views shown of the "baraban" reminded one of the horse whims one often saw in Wales. The "baraban" was an interesting example of a mining word which did not possess a German origin. In German the horse whim was called "pferde-göpel." Probably the appliance was in use before German miners were brought into the country. Speaking of the small rainfall in the Steppes, they were told that it amounted to only 11 inches per annum, and that that was due to the treelessness of the district. Did not the want of trees mean that there was a want of rain? He did not see why the absence of trees should necessarily cause a small rainfall. From what Mr. Head had said, the Russian employer looked upon the Government inspector of mines with totally different eyes from those of the English employer. He had been an inspector of mines for nearly thirty years in this country, and in many cases he had found that his visit, after a fatal accident had occurred, had been welcomed by the em-

ployer, who was pleased to have a Government inquiry. He could not understand the point in the paper to the effect that in Russia the company supplied the "Government" engineer. Possibly the Government supplied that official, and the company paid him. In conclusion, Professor Foster said he endorsed all Mr. Head had said about the welcome the Englishman received from the Russian when he visited the latter. Any Englishman going to Russia, bent on real business, having the idea of developing the wonderful resources of the country, was sure to be received heartily. In his own case, whether he met Ministers at St. Petersburg, or Government authorities at Tiflis and other places, he was warmly received.

Sir JOHN THORNYCROFT, F.R.S., said he was sorry he was quite unfamiliar with engineering works in Russia, but he felt they had heard a paper on a most interesting subject. One could only regret that the apportionment of the land to the villagers, instead of being to their advantage, apparently seemed to lead to their being anchored in one place, which he considered was not conducive to the development of the country.

Mr. L. A. RAFFALOVICH said that for many years he had been of opinion that if commercial and financial connections between the two countries had been more proceeded with, they would have led to great mutual advantage, and, most probably, to better political understanding. He was reminded of this by the tale of Charles Lamb in reference to the meeting of two friends. One asked the other, "What do you think of Jones?" "Oh, I hate him," was the reply. "Do you know him?" asked the first. "No, and that is why I hate him." He thought there was much of that in the relations between the two countries. The English and the Russians did not know each other sufficiently. Referring to protective tariffs, he said they certainly had the tendency to develop industries at a much quicker rate than where there were no such tariffs. It was only since the tariff of 1901, in Russia, which showed the firm resolve of the Government to go on and enable capitalists and private enterprises to start, knowing that they could go on undisturbed for a long series of years, that things had improved there so greatly. As to the remark of Professor Foster about the Kertch iron ore, he might say that probably the reason why the reader of the paper did not dwell upon that was because of the poorness of that ore, which did not contain more than from 20 to 22 per cent. of iron.

Mr. BAYLEY HODGETTS said there was one point which he might be permitted to raise. When Mr. Head touched upon the conditions of labour in the Russian agricultural districts he pointed out the disadvantage of the communal system. He thought, however, that gentleman had overlooked the fact that when the Russian peasant found that the land did not yield him sufficient revenue to pay the taxes which he knew he was expected to pay, he was not free to leave his village, even though he might be prepared to abandon his land. Every member of the village commune was practically responsible for the whole of the village taxes, and therefore it was found to be very inconvenient to allow a wealthy member of a village to leave just when the tax collector was coming round. A point which he considered Mr. Head had not sufficiently accentuated was that the industrial development of Russia was artificial. The probability was that this particular industry, if it was to continue at all, must continue to be artificial for a very long period; for the simple reason that anything produced anywhere is bound to be sold. As he pointed out, the only purchaser in Russia of large industrial produce was the Russian Government itself. Mr. Head, however, omitted to say that the artificial fostering of the industries by the Government was not likely to benefit those industries. Both Germany and America had developed and become wealthy through protective and artificial measures; but those countries were remarkable for the number of their towns, while Russia was remarkable for the scarcity of towns. With the exception of St. Petersburg, Moscow, Odessa, and one or two other cities, there were really very few large towns where one would get a community of so high a grade of civilization as to require certain products of industry on a large scale. He feared it would be a great many years before Russia would become a really industrial country, especially as at present the Russian peasant was said to be overtaxed. As the Government was the principal purchaser of the industrial products of large factories it followed that the more the Government purchased the more the peasant had to be taxed in order to pay for those purchases. In other words, the industrialism of Russia became really a burden to the peasant instead of a benefit. Referring to the treelessness of the country, the speaker said he considered the Government of Russia would be benefiting the country much more if it devoted some of the large sums which it was spending for other purposes to the afforestation of the country. He felt sure that would mean a great change in the climate, and with that there would be a great increase in Russia's prosperity.

Mr. E. A. CAZALET, referring to the remarks of the author that a considerable amount of capital had been launched in Russian industries by Belgium and France, said that if a little more light were thrown upon that point, it would be both useful and instructive. It was not a question of putting things right merely by getting more capital from abroad for Russia. There must surely be other means. If it was only a

matter of finding capital, undoubtedly that would soon be forthcoming.

Mr. HEAD said tha: the iron deposits were "boat-shaped," but, to be strictly technical, he might say they were lenticular. The Kertch deposits were not important. Although there might be a great deal of ore, it was not much worked. As to the condition of the coal, that applied to all periods of the year. Its liability to disintegrate was due, he thought, to insufficient compression during its formation. As to the percentage of ash, the particular coke he spoke of was the Bellair. In the cement works there was no apparatus to collect the dust. As to washing the ores dry and washing with water, he had probably not been rightly understood. He intended his hearers to understand that that from one certain district was treated dry, and that from another place was washed with water. The shaft of the manganese mine to which he had alluded was indeed very small; in fact, he had to descend in a bucket. The smallness of the rainfall, he contended, was due to the treelessness of the country and not the treelessness to the smallness of the rainfall. He regretted to say that the laws for preventing the reckless cutting down of trees had been very lax. The result was that the winds carried the moisture across the territory instead of depositing it. As to actions at the mines and Government inspections, in Russia there was a great deal of Government interference. Professor Foster was correct in assuming that the companies had to pay the official nominated by the Government. That official was practically a paid spy. His experience with reference to the English and Russian nations was that there was a kind of attraction and sympathy between them which there was not between Englishmen and other nationalities. While they hated each other as a nation they liked each other as individuals. Mr. Hodgetts spoke about the Government purchases meaning an increased burden to the peasant. So it did, but his suggestion was that the Russian Government should borrow. One way of increasing the prosperity of that country would be the increase of the middle classes. They might have to wait a long time before that came about but if that class only did increase, it would mean the increase of enterprise and energy, the Government would no longer be the only customer, but there would be general prosperity. In conclusion, Mr. Head drew attention to the following extract from a report of the Russian Collieries Company, Limited, with whom the chairman that evening, Mr. Hubbard, was connected:—"The estimated production of iron ore in 1903 is 187,861,800 poods, and of flux 33,572,400 poods. In the iron producing district of South Russia there are 19 ironworks owning 56 blast furnaces, of which, in the current November, 25 are in blast, 2 are in course of erection, 12 are undergoing repairs, and 17 are temporarily standing idle. The estimated production of pig iron during 1903 amounts to 86,100,000 poods; the quantity required for conversion into blooms, 72,320,000 poods, for iron and steel merchant bars 62,120,000 poods, and for iron and other metallurgical purposes 12,124,000 poods. The statistical survey of the mining and metallurgical industries of South Russia points to a continuation of the existing depression of trade in these industries for some time to come. There is one complaint which is common to these industries, namely the great divergence between supply and demand, the former greatly exceeding the latter. The estimated supply of coal is less than the producing power of the mines by 27 per cent., and the demand only amounts to 63 per cent. of the estimated supply; the estimated production of pig iron is only 52 per cent. of the producing power of the blast furnaces. It must also be borne in mind that the stocks of coal at the beginning of 1903 will amount to 40,000,000 poods, and the stocks of pig iron to 12,150,000 poods. These statistics throw an unfavourable light on the prospects for 1903, and point to the urgent necessity of firm measures being adopted by the Congress of the coal and iron trades, with a view to establishing a more healthy condition of affairs and, as far as possible, to render the demand more consistent with the estimated supply."

The CHAIRMAN moved a hearty vote of thanks to Mr. Head. He could endorse all that had been said about the necessity for a better understanding between the English and Russian nations, and could bear testimony to the good fellowship which nearly always existed between them. He advocated the extension of Russian railways, and he differed from Mr. Head when he said that those railways were built entirely with strategic views. If they saw the network of railways which now intersected the Donetz coalfields, they would feel convinced they were not entirely for strategic purposes. In conclusion, the Chairman said there was every desire to develop Russia and bring it forward in the great race among nations as speedily as possible.

Miscellaneous.

THE SIBERIAN RAILWAY.

A report on the trade of Siberia, by Mr. Henry Cooke, British Commercial Agent in Russia, lately issued by the Foreign Office, contains much information respecting the Siberian route. The entire stretch of rail in Asia, generally known as the Siberian Railway, covers—

In Russian territory	Versts	5,372	or 3,581	Miles.
,, Chinese ,, ...	,,	2,420	,, 1,613	,,
Total ...	,,	7,792		

Regular traffic is now open to the Manchurian

frontier station. By next year the entire route from Europe to the Pacific will be open to the public service. Trains, indeed, have already run through to Wladiwostock and Port Arthur. In August of this year, according to official telegrams, Prince Komatsu and suite accomplished the whole journey from Moscow to Port Arthur by a special through train in just short of 14 days. Hitherto, however, traffic across the Manchurian section has been mainly for official purposes and favoured passengers. As regards the one break in the through route to the Far East, the short stretch round the southern bend of Lake Baikal is to be ready by January 1, 1905.

It is intended that within the near future passengers may be able to reach Dalni in 18 days, Peking in 19 days, and Chinese or Japanese ports in 20 to 21 days, from Central European towns, counting two to three days from the latter to the western frontiers of European Russia. While by the Suez route the journey from London to Shanghai, Nagasaki, or Yokohama, takes 34 to 37 days, and costs r. 700 to r. 780 1st class, *viâ* the Siberian rail, it will be covered in 18 to 20 days, at a cost of from r. 350 to r. 390, while later both time and expense may be further shortened. The Moscow-Zlatoust-Samara line is the only main one connecting European Russia with the Siberian Railway.

Prospects.—Russians, apart from its political or strategical aspects, look rather to its future potentialities (1) as the connecting medium between their new Far Eastern possessions and the heart of Russia, and as another outlet to the ocean; (2) as the means of facilitating and furthering direct trade in the future with China and Japan; (3) as a great transit route for passengers, goods, and mails between west and east, and *vice versâ*; and (4) as the instrument for the colonisation and opening up of Siberia. As regards the latter, the railway has rather to create than to carry a traffic.

The immigration of peasantry from European Russia to Siberia and the Far East seems for the present to have reached its culminating point in 1899. It has risen from a total of 61,435 in 1893 to 223,981 in 1899. In 1900 the number was 219,000, and last year 128,131. Especially noticeable is the increased number of emigrants who returned last year to European Russia, chiefly under the influence of the bad harvests of 1900 and 1901 in many Siberian districts. Probably, too, the best arable and more accessible plots of land had been already apportioned to their predecessors in this movement. Whatever the reason, 55,233 re-entered Russia, including 31,330 actual emigrants, 18,019 "khodoks," or pioneer emigrants, sent out ahead to reconnoitre on behalf of groups of would-be settlers, and 5,884 peasant labourers returning from temporary work. Of the 18,019 pioneer emigrants who returned, 13,647 had come to no arrangements.

The gold and other mineral industries, although the former at least has shown little progress of late, may be developed by the wider opportunities now opening, and by the greater accessibility to modern mechanism and methods generally. Nor, of course, can Siberia do otherwise than benefit from its intermediate position in the international through traffic that is bound to follow.

Working Expenses.—The working expenses of the line in 1899 are taken at r.5,000 per verst, or, if the Manchurian section be now included, at r.6,000. In all, taking the length at 7,792 versts, the approximate working expenditure would amount to r.47,000,000 a year, not including interest on capital, &c. To cover expenses the receipts should reach about r.80,000,000, which would require the carriage of 600,000,000 pouds of goods annually at the existing high tariffs, or, merely to cover working expenses, 370,000,000 pouds. The gross receipts on the Siberian line proper (Cheliabinsk-Irkutsk) in 1901, including passenger traffic, were r.15,259,854, against r.13,838,577 in 1900, or r.4869 per verst in 1901, against r.4,415 per verst in 1900. On the Trans-Baikal line they amounted in 1901 to r.4,178,377, against r.2,116,649 in 1900, or r.3,568 per verst in 1901, against r.3,863 per verst in 1900. With regard to the traffic possibilities of the future it is early as yet to speak with any definiteness. Mr. Selikhoff, the Assistant Chief of the Commercial Section of the Siberian Railway, from calculations set forth in detail, estimates the minimum goods traffic of the Siberian and Trans-Baikal lines within the near future at 190,000,000 pouds (3,062,990 tons), or, including the Manchurian section, 300,000,000 pouds (4,836,300 tons). The capacities of this great through thoroughfare as the world's carrier east and west can be, however, under present conditions at least, but roughly and indefinitely estimated. It is safe to say that the line is not at present, and may not be for years yet, in a position to cope with anything like the possibilities and requirements that the future may reveal or exact. Russo-Siberian traffic alone, pending the population and development of the country, can influence but little the scale of cost and gain. To what extent the railway will realise expectations in international traffic the near future should assist in forming an estimate. Trade circles are still feeling their way, and rival routes striving to maintain their former supremacy. Cheap and cumbrous commodities can hardly bear the charge of so prolonged a land journey. The sea will probably hold its own in the carriage of all but valuable cargoes, perishable articles, and goods deliverable by fixed date. But hopes, too, are placed on passenger and mail traffic, to meet which, in anything like the proportions expected, the entire accommodation and arrangements would have to be considerably extended.

Should expectations be realised, this single track will have to bear the immigration movement, the internal circulation of Siberia itself, the possibilities called forth by the opening out of the dormant resources of the country, and the international through-traffic in passengers, mails, and goods, not to mention the claims of official and military necessities.

This is in addition to its present goods traffic to and from Russia. New feeding lines too, such as the St. Petersburg-Vologda-Viatka Railway now building, must in time pour an additional burden on to the carriage capacity of the main route. With, on the one side, the resources and enterprise of Europe, and on the other the teeming populations of the East, and midway an undeveloped expanse surpassing in extent the whole superficies of Europe, but which can be traversed in 10 or 12 days, it would be difficult to over-estimate the future that lies before this masterful undertaking. That future may be somewhat distant yet, as at present the railway is ahead of the country it serves, which needs first peopling and then developing.

International Mails.—No train accommodation is yet provided for the international mail transit traffic the new route is expected to attract. From detailed calculations, worked out to moderate and minimum figures from postal data of the countries likely to avail themselves of the shorter route, the above-named authority estimates the future transit mail carriage at 1,000,000 pouds (16,121 tons), requiring two to three special carriages from each end per diem by, of course, express or mail trains. Existing international postal arrangements would need modification before any profit to the railway itself, as an intermediary only, could be derived from this mail traffic.

Grain occupies the first place in the goods traffic of the Siberian line. Now, too, with the establishment of direct communication, viâ Riga, Siberian butter reaches the London market direct, and not under Danish marks, or *viâ* Denmark only.

The United States Consul-General at St. Petersburg, writing under date of 26th March, 1902, reports that it is officially announced that the express between St. Petersburg and Vladivostock was to be started by the 15th April (1902), and, according to the *Journal de St. Petersburg* (official organ), "the Directors of the Chinese-Eastern Railway propose to organise next autumn a regular through service between that line and the Russian railway system" to the Port Arthur terminus), "and that henceforth there will be five Russian steamship services connecting the Trans-Asian Railway with ports in China and Japan, to which there will be a considerable extension as the railway acquires importance. The *Engineer* referring to this new route, says:—

"Nearly 10,000 miles of the new route between Adelaide, Melbourne, Sydney, Brisbane, and London, are covered by railway. The recognised line opens for serious traffic at the end of 1903, and there seems no reason to doubt it will give easier, quicker, and cheaper traffic than at present by the all-water route. Its existence as a competing route may be delayed for want of railway transport to the gateway, or, in other words, from the Southern Australian capitals to Port Darwin; but, nevertheless, the great Siberian Railway, which is destined to play a most prominent part in the immediate history of the Far East and Australia, will prove such an important factor in the domestic traffic across the Australian Continent, as to make it desirable, if not certain, that the completion of the line to Port Darwin should before long be undertaken."

SWEET POTATOES FROM BARBADOS.

The wet summer that has been generally experienced throughout the British Isles has unfortunately been the cause of much anxiety among potato growers and consumers in arousing fears of short crops, inferior quality, and the prevalence of disease. Recent statements, however, have shown that the crop has not been so bad as was anticipated, though the quality is not a high one, owing to the prevalence of disease. Fortunately for Ireland, the crops are stated to be one of the most bounteous ever harvested, and that further, there is little indication of disease.

The potato being an almost indispensable article of food, it is satisfactory that we have not to depend alone upon the produce of the United Kingdom for our supplies, for we can draw very large quantities not only from France, Belgium, Holland, and Germany, but also from the Argentine and other places.

At periods of great scarcity in the potato supply, attention has frequently been directed to possible substitutes, but many of these have had but little to recommend them, besides which there is always much difficulty in inducing people to overcome prejudice against new products, especially in articles of food, without there is absolute compulsion. There is, however, a tuber closely allied botanically to the common potato, which, though it is not unfrequently seen in the shops of most large towns is comparatively unknown in ordinary households, but which might probably become an article of considerable import into this conntry from many of our colonies, were more attention drawn to it. This is the sweet potato, experimental shipments of which have been made in the early part of this year from the West Indies, the results of which were recently discussed at a meeting in Barbados, and reported in the *Agricultural News*. Dr. Morris, C.M.G., Commissioner of Agriculture, pointed out that when the matter was first started, an appeal was made to a few planters only to join in the experiment, the most cordial co-operation was at once received, and during the whole of the period, from December to May, a certain number of barrels of sweet potatoes was shipped by each mail to appointed agents in England. The potatoes were put upon the market, and sold for whatever they would fetch. The matter having passed through this preliminary stage, it was now to be thrown open to the whole island.

Planters, however, were warned to bear in mind that the exportation of sweet potatoes still demands

careful organisation, there being yet only a limited demand, any large and unexpected shipment might easily swamp the market. It was pointed out as essential that there should be definitely appointed agents ready to receive an arranged number of barrels of the tubers, just as many, in fact, as can be disposed of immediately they arrive. What was wanted was a regular supply of produce of good quality and suitable size delivered in Bridgetown a day before the mail leaves.

For the guidance of intending shippers, the following regulations for preparation and packing have been drawn up and circulated. Potatoes intended for shipment to the English market should be dug on the Monday preceding the Saturday on which the Royal Mail Steam Packet Company's steamers leave Barbados. They should be then spread on the floor of a dry, well-ventilated room until the following Friday, when they should be packed in barrels and shipped at once. The barrels recommended for this purpose should have about a dozen equi-distant clean cut holes of $1\frac{1}{4}$ inch diameter bored in the sides, for ventilation. The object of drying the potatoes for a few days before they are packed, is to harden the skin, and so prevent its being badly bruised. Each tuber should not be less than twelve, nor more than twenty ounces in weight; bruised tubers are rejected, and the red variety is preferred to the white.

At a time when a distinctive name for every new product seems to be of especial value, the suggestion of Sir Frederic Dodgson that sweet potatoes, exported from Barbados, should henceforth be distinguished as "Barbados potatoes" in all trade dealings, is a good one, and oue that will probably be generally adopted.

ARTIFICIAL MARBLE IN DENMARK.

The United States Consul at Copenhagen states that the lack of marble in Denmark has led to many attempts to produce a substitute which would equal in decorative effects the natural product and would not exceed it in cost. Some success has been achieved in the manufacture of this article in Sweden, but the thin slabs would not keep their shape, inclining to bend and warp. The veins were stiff and angular, and the soft transitions of colour which make variegated marble a thing of beauty were wanting. A significant advance has been made in this industry in Denmark by a master builder of Copenhagen named Sven Schongaard, who is producing a stone of such delicate transition of tints and play of colour that it is difficult to distinguish it from the natural product; while as to cost of manufacture it can compete with all other artificial marbles. The imitation of the more expensive species does not exceed in cost that of the cheaper ones. The inconvenience hitherto met with that the mass bad to be greased to prevent adhesion (thereby destroying the crystalline surface characteristic of the genuine article) has been overcome. The process of mauufacture is simple and easily learnt, and the cost of the outfit is said not to exceed £35. The article can be produced in any form desired—columns, plain or fluted, and capitals—as readily as flat slabs. It is claimed that even pictures may be made of this material. It seems to have the durability of genuine marble, but its cost is only about one tenth. At the present stage of the development of the industry, the maker is able to produce a slab about half an inch thick at a cost of about 7d. per square foot.

General Notes.

Well Sinking in Cape Colony.—Sir W. Willcocks, K.C.M.G., writes in his "Report on Irrigation in South Africa":—The extraordinary success which has attended deep bores in South Western Queensland has not been obtained in Cape Colony, nor ought it to be expected. In South-West Queensland, the rains which fell to the west of the dividing range along many hundreds of miles are absorbed by the ground and never reach the sea, and must have laid up rich stores of water which are available for use to-day. In South Africa the rain water everywhere escapes to the sea, and the sub-soil water can only be very local and insignificant in quantity. Shallow wells and windmills have, however, been a great success over large stretches of country, and have helped to save hundreds of thousands of sheep in years of drought. Since 1890 the Cape Colony Government has been boring holes for water with the aid of a special staff and implements. The general results up to the end of 1898 are, approximately, as follows:—

Number of holes bored—2,600.
Successful—about five-sixths.
Unsuccessful—about one-sixth.
Cost of boring—per hole, £17.
Average depth of hole—60 feet.
Total discharge of water—26 cubic feet per second.
Discharge per hole—$\frac{3}{4}$ cubic feet per minute.
Practically all the holes need machinery of some kind to lift the water.

This quantity of water is insignificant for irrigation, but for watering stock it is of the utmost value to the colony.

MEETING FOR THE ENSUING WEEK.

Tuesday, Dec. 23...Institution of Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on Mr. Stephen Martin-Leake's paper on "The Rupnarayan Bridge, Bengal-Nagpur Railway."

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Wednesday Afternoon, December 31st, 1902, at 5 o'clock. (Juvenile Lecture.) Professor Edward B. Poulton, M.A., D.Sc., F.R.S., "Means of Defence in the Struggle for Life among Animals." (Lecture I.)

The course, as usual, consists of two lectures:—

Lecture I.—"The Methods by which Animals hide in order to escape their Enemies and catch their Prey."

Lecture II.—"The Ways in which Animals warn their Enemies and signal to their Friends."

Members who desire tickets for the course are requested to apply for them at once.

Each member is entitled to a ticket admitting two children and one adult. As the full number of tickets has not yet been distributed, members applying can still be supplied.

Members are reminded that admission cannot be obtained without a ticket.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

INDIAN SECTION.

Thursday afternoon, December 11, 1902, Earl Percy, M.P., in the chair.

The Chairman, in introducing the reader of the paper, said that Miss Sykes had long ago obviated the necessity for any formal introduction to a British audience by introducing herself in the pages of a particularly interesting and charming book upon Persia, which was familiar to all lovers and students of Persian things. Miss Sykes first went out to Persia in the company of her brother, when he was charged with the duty of initiating the British Consulate at Kerman, and, in the course of her joint expedition with him, both in the mountainous country to the south of Kerman and between that province and the north-west corner of Baluchistan, she traversed a good deal of country which no European lady had ever traversed before. In the course of the many months which she had spent in Kerman itself she had unrivalled opportunities for acquainting herself with the particular subject which she had chosen as the topic of her address.

The paper read was—

DOMESTIC LIFE IN PERSIA.

By Miss Ella C. Sykes.

In order to understand Persian domestic life, we must carry ourselves in spirit back to the patriarchal age. In Persia, at the present day, the master of the house is lord, much in the same way as were Abraham and Jacob. He has large powers over the persons of his wives, children, and dependants, being able to treat them pretty well as he pleases.

Owing to the seclusion of the women, he is practically the sole judge to whom his wives can appeal, and though there are certain laws for their benefit in such cases as divorce, yet it can easily be seen how difficult it is for them to get justice. In fact, a wife is looked upon as a chattel, a possession of which her husband is jealous, more from etiquette than from affection.

With the children it is something of the same kind: they are not individuals, but property belonging to the father, who makes but little account of his daughters, and only cares for his sons if they are handsome and clever.

Then come the servants. They occupy a curious position, chatting freely with their masters, offering them advice on all occasions, collecting gossip from the bazaars with which

to amuse them, and yet liable to the *bastinado* for trivial offences. They seldom change their situations, and the children of servants are frequently educated with those of their master, joining them in their sports on terms of the greatest intimacy. Yet, as a Persian gentleman explained to me, these customs are not from lack of the caste feeling, but rather because the divisions between the different classes are too clearly defined to be bridged over.

It is amusing when receiving a Persian of position, to notice how his servants, and yours for the matter of that, will burst into the conversation at intervals, leading it much as they choose. That passage in the Old Testament where Naaman refuses to obey the Prophet's command to bathe in the Jordan, and is argued with, and finally persuaded by his servants, is a true picture of the relationship between master and servant in Persia at the present day. Any gentleman intimate with another will invariably enquire after his friend's chief servant, and address some of his conversation to him, and it is a mark of special friendliness to give orders to another man's retainers. A Persian Prince, who often dined with us, used to send our servants (who were waiting at table) for this and that, and I confess that I thought his manners strange, until it was pointed out to me that he was paying us a particular compliment.

Also when we rode with our Persian acquaintances, the latter would by no means accompany us the whole time, but would very soon hang back to gossip with our grooms, presumably questioning them about us and our strange European ways.

All servants are fed and clothed by their masters, and are supposed to get a certain amount of cash, at all events in the towns, but this I fancy they seldom see, as it is extremely difficult to get ready-money out of a Persian. A European friend once asked a Persian how it was that his servants stayed in his situation when he never paid them any wages, and he answered with a laugh, "I keep them by means of lying promises!"

If there happen to be any poor relatives, they are treated much like the servants, and act the part of hangers-on for free board and lodging.

Slaves, strange as it may seem, are most important and considered members of a household. For one thing they are valuable, and must never be put to do hard work, and the Persian theory is that as they have no ties of their own they will be the more likely to identify themselves with the interests of their masters. Accordingly, a Persian will entrust his money and property to his slave, and often confides his children to him on his death-bed. This relationship, however, is fast dying out, as the supply of slaves has been cut off, and it is now very difficult to smuggle such contraband cargo into the country.

The dwelling-houses in Persia are always built round courtyards into which the doors and windows open, and are enclosed with high walls, over which it is impossible to see. A heavy door on the street admits the visitor into the *biroon*, or outer apartments. These are only used by the men, and are generally scantily furnished rooms opening on to a tank in the middle of a badly-kept yard. No idea of the wealth or culture of a Persian can be gained from his *biroon*, where he transacts his business, and receives his friends. These, by the way, however intimate they may be, must never ask after or allude to their host's wife and family, except by the vague term of *khana*, or "the house."

A dark passage, with a door at the far end, leads from the *biroon* into the *anderoon*, or women's apartments, and here things are very different. Flower-beds surround the courtyard tank, and the rooms have rich carpets, silken divans, enormous silk-covered cushions, and are decorated with inferior European pictures and knicknacks, frequently in the worst possible taste. Occasionally, however, some conservative Persian will cover the ceiling of his room with scraps of mirror set in the plaster at different angles, making an exquisite decoration, or he will have rows of graceful niches along his walls, in which he will place quinces, the odour of that fruit being particularly grateful to Persian nostrils.

Here the master of the house is in the bosom of his family, and with his shoes left at the door, and his astrachan hat replaced by a felt skull-cap, he is at his ease, though the long-skirted frock-coat and the European trousers, now worn by all, are not ideal garments for a nation which sits on its heels, and only uses chairs when Europeans are present.

A Persian's day is somewhat as follows:—He rises about six o'clock, a servant pours water over his hands, and he bathes his face, and then prostrates himself in devotion on his prayer-carpet. A glass of much be-sugared tea and some almond-paste serve him for breakfast, after which he begins the work of the day. The term "work" is perhaps some-

what misleading when applied to a Persian, who does not happen to be a governor, a merchant, or a peasant, all of whom have occupation enough and to spare.

Most of the country gentlemen possess villages, and of course see that the peasants till the land farmed out to them properly, and there is a busy time when the crops are gathered in and the wine is made. But apart from this, it appears to be ample occupation to act as hanger-on to the Governor or great man of the place, and, if at Tehran, to the Shah and his Vizier. Certainly, this *rôle* takes up a considerable amount of time, for the would-be courtier spends his entire mornings in the large hall where the Governor dispenses justice. This is dignified by the name of "doing service," and the magnate thus honoured looks upon it as a compliment.

Again, talking is a never-failing resource, and Persians so greatly enjoy discussions on religion, that I fear some missionaries, on first arriving in the country, may have entertained vain hopes of speedy conversions when they saw how ready the educated men were to hear about the doctrines of Christianity. The love of *gufti gu*, or chatter, is engrained in every Persian and, at night, the servants will tell stories into the small hours of the morning unless checked by their employers.

Music and dancing are also much practised. Although no gentleman would degrade himself by doing either personally, yet he will listen for hours to the twang of the *sitarrah*, the thud of the *tom-tom*, and the falsetto voice of some trained singer.

The cult of the supernatural is a constant occupation. No journey can be taken, no doctor called in, often not even a new suit can be worn without consulting the astrologer, and no one would enter a city or house for the first time, or close any important bargain, unless the omens were auspicious. Again, there are many unlucky days, no one, for example, ever commencing any undertaking on a Friday, which is the equivalent of our Sunday.

A traveller may have secured good omens for a journey, yet if he or anyone else chances to sneeze as he mounts his horse, he will almost certainly put off his start to another day. The less superstitious will repeat a certain invocation to Allah, which is supposed to nullify the bad effect of the sneeze, but even these partially emancipated spirits will proceed on their way haunted by a sense of impending disaster.

Persians also believe that a day is lucky or the reverse according to whose face they have looked upon first on awaking. The "lucky" face or its contrary can only be discovered by experience, but such people as public executioners and their children are always credited with unlucky visages. It can be understood from this that a master is very particular which servant calls him in the morning.

When other ways of filling up his day fail him, a Persian has recourse to slumber. He appears to be able to sleep at any odd moments; and once my brother counted up the time spent in this occupation by a gentleman whom he knew well, and made it out to be sixteen hours in the twenty-four. While agreeing with the amount, our friend said that during a good deal of the time he was not actually asleep, but was meditating on pleasant things while lying down! Certainly, no Italian understands the art of *dolce far niente* better than a Persian, and out bustling, energetic lives seem the height of folly to him. He is well content with the world of Omar Khayyam:—

> "A Book of Verses underneath the Bough:
> A Jug of Wine, a Loaf of Bread—and Thou,
> Beside me, singing in the Wilderness,"

the "Thou" in his case being no fair lady, but a hired musician.

A Persian Governor, however, is a really busy man, for having given a large sum to the Shah for his province, he has to work hard to wring money out of his unlucky subjects wherewith to recoup himself. At an early hour he will proceed to his hall of justice, which will be filled with men of position, anxious to pay court to the powers that be, with numerous retainers, and with a crowd eager to get their cases settled, for the Governor of a province is also its magistrate and judge.

In Persia, the man who has the longest purse wins his suit, and the bystanders naturally take a keen interest in the judgments dealt out. The Governor by no means confines himself to large matters. Like Moses, before the Lawgiver followed Jethro's excellent advice, the Persian ruler adjudicates on the most trivial details, appearing to have no sense of proportion. His *ferashes* are in readiness to carry out the punishments he may decree, being prepared to cut a man's throat, take off a hand or an ear, blind an unlucky prisoner, or subject him to the *bastinado*.

At noon a leather cloth is brought in, and unrolled upon the floor, and metal bowls

of food are placed upon it. When the Governor and those whom he invites to share this meal have done their mid-day devotions, they partake of *pillaus*, *chilaus*, *kabob-i-sikh*, and other dishes, helping themselves with their hands, and drinking glasses of sherbet. When this meal is cleared away by the servants who feed on what is left, everyone has a *siesta*, and later on, if the Governor be not too busy, he may ride out to some garden with his friends. Here he will smoke innumerable *kaliàns*, drink tea or wine, and quote from Hafiz and Sadi to show his culture. Probably he and his party will have another sleep in the hot afternoon, lulled by the rippling stream which flows through every Persian garden.

If, however, he is a man of active tastes he will be a devotee of sport, riding out on the plains with his friends and retainers to chase the gazelle. This is done by enclosing the animals in a circle, which becomes narrower as the riders get nearer. When they are close upon the gazelles, the latter try to break through the ring, and an exciting moment ensues of rather indiscriminate firing, which often results in casualties to the hunters as well as to their quarry.

Or a partridge shoot on horseback may be organised. A narrow valley is often selected for this sport, the riders scouring the hills on either side, and galloping along precipitous ridges in order to force the active little *chikor* down into the gorge, where eager sportsmen fire upon them at the closest of ranges. Mongrel pointers are on the alert to put the birds up, and frenzied falconers gallop to and fro, letting loose their hawks and shouting wildly. One and all appear to use their guns very carelessly, and the hurly-burly and excitement are quite indescribable.

It was on one such occasion that as we were starting from camp in the company of our host, a certain Persian prince, his favourite servant galloped up to us calling out the magic word *shikar*. At once the whole party stopped, and the Prince dismounting, cocked his gun and cautiously approached the game. I was puzzled at seeing no partridges, and my surprise was not lessened when our host fired at a small bush out of which suddenly emerged a fine magpie, which flew off unharmed!

After the work of the day, the Persian evening meal, if eaten in company, is not served till close on midnight. Before the dinner proper appears, the guests spend two or three hours eating dried fruits and almonds and drinking wine, unless they are stricter Mohammedans than is usual. The belief that for each glass of wine drunk on earth the expiation in the next world is a draught of peculiarly loathsome water, does not seem to deter them in the least from partaking of the forbidden luxury.

When dinner, a replica of the midday meal, comes at last, everyone goes to the tank in the courtyard to wash his hands and mouth. If this ceremony were omitted, the wine drunk would defile the dishes in which the food is served, and they would have to be subjected to a laborious scraping before being used again. Then the meal is eaten in the greatest haste, hands and faces are washed, coats and hats removed, and everyone goes to sleep.

This custom, which seems likely to induce nightmare, may have something to do with the universal belief that ghouls and demons are on the alert at night ready to destroy the unwary, and many rich men pay a priest to sleep with them on this account.

Such unpleasant supernatural visitants as *ghouls*, *divs*, *jins*, *afrits*, and the like, have to be constantly taken into account, and the boldest Persian would hesitate to venture unaccompanied into a lonely graveyard, or a deserted ruin. They say, however, that these places would be divested of their terrors if a European were present, the reason given being that the bogies only reveal themselves to those who believe in them.

Having given a glimpse of the life of a Persian gentleman, I will now turn to the ladies, whose existences, according to European ideas, are decidedly dull and restricted.

When we consider that except her relatives, the only man who has the right to look upon a woman's face, is her own husband, it may easily be understood that there is practically no social intercourse between the sexes.

A Persian told me that it would be entirely against etiquette for him to salute his mother or wife did he meet them outside the house, and happen to recognise them under the shapeless black shrouds in which they would be huddled.

No gentleman is ever seen with his wife in public; he cannot ride, drive, or walk with her—in fact the couple have so few interests in common that he spends his days with his men, and she with her women friends.

If she is one of the wives of a rich man she will have her own establishment, but supposing that the husband is poor, he may have more than one wife under the same roof. There is a significant Persian proverb to the effect that, "Two mistresses cannot be at peace in one house," and the quarrelling, intrigue and heart-burning that inevitably ensue in such a case, may be left to the imagination.

Persia, however, is becoming monogamous, and Persians themselves say that it is unfashionable and provincial to have more than one wife, but really it is the general poverty of the country which is chiefly answerable for this change in Mohammedan custom. Certainly there is a saying, "It is easier to live with two tigresses than with two wives," but I fancy that few men would hesitate to make the venture if only their means were sufficient.

The Persian girl is brought up with her brothers until she is eight years old, and usually it is not considered worth while to teach her reading or writing. She learns how to make sherbets and sweets and to embroider, and is married at an early age, usually to a cousin.

Betrothals are often arranged by a professional go-between, who is treated with much respect by all who have marriageable sons and daughters, as it is in her power to make or mar a match. Supposing that a desirable *fiancé* is found for a girl, and that her dowry is satisfactory, the gentleman's mother and other female relatives pay a visit of ceremony to inspect the young lady. Of course, the girl knows for what purpose they have come; and if the idea of the marriage has not found favour in her eyes, she will hand the tea and water-pipe to her would-be mother-in-law in such a rude fashion that the negotiations will be brought to an abrupt conclusion.

On the other hand, she may know her proposed husband well by sight, as her servants may have pointed him out to her in her walks, and if his appearance has pleased her all goes smoothly.

In her turn she and her relatives will go to drink tea at the house of her intended *fiancé*, and she will try and look her best, knowing that the young man, hidden away on some balcony, is anxiously watching his mother, who will point out to him his future wife.

He is not supposed to see her face until the formal betrothal by the priest takes place, and then, indeed, she will be so rouged and powdered and her eyebrows and eyelids so blackened with antimony that it will be hard for him to gain any clear idea of what her natural charms may be. However, if what he sees displeases him he may draw back by paying to the lady's parents half the sum of money that they had agreed to give as dowry, but a man behaving in this way is socially disgraced.

At the ceremony of betrothal a lighted candle, the Koran, and a mirror, together with a tray on which are tapers, perfumes, dried seeds and dates, are placed close to the girl and a green covering thrown over her. She must not speak to anyone, and a lighted lamp is then put beneath a large brass basin turned upside down, and on this latter a saddle and pillow are placed, and she sits on the pile to indicate the mastery of the husband. The same green covering conceals her later on during the marriage-ceremony, and when wedded she is given a piece of gold for luck, and carries bread and salt into her husband's house to ensure plenty, kissing the hearthstone of her old home as she leaves it.

The marriage is a grand affair, Persians often going deeply into debt on these occasions, as they feast their friends, the priests, and the beggars on a large scale, and entertain them with hired musicians and buffoons. It seems a matter of chance whether the young wife has a happy life or the reverse, as her fate depends so greatly on the character of her husband, and also whether she becomes the mother of a son. She can be divorced with ease, and, at any rate, a cruel blow can be inflicted upon her by the addition of a second wife whom her husband may prefer to her. From early youth the husband has been taught by the priests to pay no attention to the counsel of a woman, in fact, that he had better act in every way contrary to her advice. He also believes that women have practically no souls, and that he will never meet those he has known on earth, when he attains to the material Paradise of the Mohammedan. *He* will be tended by fair *houris* who sing entrancingly as he sits beside the River of Milk, or stretches his hand towards the delicious foods with which the boughs of a certain wondrous tree are laden. *She*, on the contrary, may be writhing in hell, as the Prophet told his followers that when he was permitted a glimpse into the infernal regions the vast majority of the victims there were women.

Only by continual effort, and by making

pilgrimages, can a woman be admitted into the paradise reserved for her sex, which is a very inferior place of residence to that which her male relatives will inhabit, with apparently but little trouble on their part.

There is certainly a good deal of wifely submission in Persia, and only once did I hear of a hen-pecked man. On one occasion, I remember calling on a lady when her husband was present, and the latter asked me whether I thought his wife was pretty, much in the way that he would have discussed the points of a horse or a dog. I noticed how ill at ease the poor woman was, and he actually pointed this out to me, adding that if they were at table together, she would tremble in every limb from fear of her lord and master. After this experience, I was not surprised that nearly every native lady I met advised me earnestly not to wed a Persian, assuring me that they made very bad husbands. This was quite a spontaneous warning on their part, because I always made a point of never comparing their lives with my own, fearing to stir up discontent, for which I could offer no remedy.

However, I was by no means so reticent with the men when they compared European and Persian women to the disadvantage of the latter, and I soon saw that the more thoughtful were by no means content with the status of their womenkind. I remember one man exclaiming in a burst of indignation, "It is all the fault of our cursed religion, which binds us in chains, as well as our poor women!" This is neither the time nor the place to discuss Mahommedanism, but it always appeared to me to be one of the most petrifying of religions, seeming to hold its devotees in a grip that admitted of no progress or expansion.

In Persia, Friday, as in all Mahommedan countries, is the great day of the week, every pious son of the Prophet repairing to the bath, and then to the Mosque.

The ladies, however, spend their time in the former place, and, indeed, we cannot blame them, for the only accommodation provided for them in the House of Prayer is an enclosure screened off from the rest of the building by a closely barred lattice, through which they can get glimpses of the proceedings, while remaining unseen themselves.

They use the bath as a kind of club. There they meet their friends, show off their new dresses and best cushions, and are particular as to the embroidered cases in which they carry their toilet requisites. Accompanied by their children and servants, who are admitted free of charge, they pass the entire day in the hot, steamy atmosphere, gossiping while their hair and finger-nails are dyed with henna, and their eyes and eyebrows decorated with antimony.

There is a good deal of sociability among these ladies, and they are fond of having their friends to stay with them—indeed an acquaintance told me that, by skilful use of lucky and unlucky days, a lady would inflict visitors upon her husband, who is obliged to make himself invisible on these occasions, for longer periods than he liked. For example, those who were in a house on Saturday must stay there on the Sunday night, while any who arrived on the Tuesday or the Thursday were forced to spend the Wednesday or the Friday under the same roof, an earlier move bringing ill luck to all concerned.

Persian women frequently give parties, and on these occasions wear their best dresses and jewellery, a man being looked upon as a good husband according to his capacity of providing finery for his wife.

At Tehran, a lady will pay a large sum at the European shops for a piece of brocade, and will wear it ostentatiously in order to excite the envy of her guests. Retribution however, may overtake her, for one of her visitors will perhaps buy more of the same material, and have it made up for her slave-girl. She will then invite all her acquaintances, and tea and water-pipes will be handed round by the slave dressed in the rich silk in which the quondam hostess is probably arrayed. Later on the same girl will dance before the assembled guests to the intense mortification of the one and the keen amusement of all the others!

When a Persian woman is advanced in years, she often thinks of that inferior paradise to which she can so hardly attain, and she will persuade her husband to let her go on a pilgrimage. If possible, Mecca or Kerbela will be her goal, though if lack of means put these shrines out of her reach, Mecca in particular requiring a long purse, she will perforce renounce the coveted titles of *Haji* and *Kerbelai*, and be content with that of *Mashtadi*.

But even the journey to the famous shrine of Imaum Reza at Meshed is a serious affair for a woman. She must travel in the jolting *kajaveh* or pannier strapped on to a mule, and in which she must sit in a very cramped position, unless she can afford the expensive swaying *takht-i-ravan* or litter.

We must also remember that her outer garment is a black silk shroud in which she is covered from head to foot with the exception of a strip of lacework over the eyes, and that however hot the weather may be, she cannot uncover her face, and however ill she may be she has no better hotel than the miserable *caravanserai*, with only recesses innocent of doors and windows opening off from the courtyard. Her servants will sweep out one of these cells, lay felts and her bedding on the mud floor, and hang a carpet across the opening, and here she must pass the night in close proximity to the camels and mules, and probably be kept awake by the conversation of the muleteers lying just outside.

When the goal of her journey is reached after many weary days if not weeks of travel, she will probably settle down for a year, visiting the Mosque daily, and presenting offerings of gold and jewellery to the shrine. She will pay a priest to recite portions of the Koran to her, as it is improbable that she can read the sacred book herself, and she will pass much of her time chatting with friends from her native city who meet her in the screened-off part of the Mosque.

She does not trouble herself about the husband and children whom she has left, for she has never seen much of the one, and the others are safe in the care of a faithful slave. As for the house, she has never been its real mistress, her husband having always managed the servants and paid for everything; therefore, it will goon just as well without as with her.

We must now turn for a few moments to the Persian children. For some time after birth they are kept tightly bandaged, and I fear are often dosed with opium if fretful or sleepless. Their mothers and nurses are constantly occupied in their endeavours to ward the evil eye from their charges. Blue is supposed to be the best colour for this purpose, and many children wear an amulet made of a sheep's eye brought from Mecca, into which a turquoise is stuck. Another plan is for rich parents to dress their children in very shabby clothes, lest anyone admiring the young folk and omitting to add the saving word *Mashallah* (God is great) to their remarks should bring disaster upon them.

Most childish and, indeed, most adult illnesses are put down to the evil eye, and the cures are all more or less a question of charms. For instance, a poor baby suffering from water on the brain was brought to a Persian doctor who assured the parents that it was possessed by a demon. His prescription was as follows. The father was to lay his child in a newly dug grave and leave it there for the night. In the morning it would either be cured or made away with by the demon. The parents followed the doctor's advice, and next day great was their surprise to find their baby sleeping in its strange bed neither better nor worse from this novel cure.

But there is no end to the remedies to which Persians will resort. Some are extremely unpleasant, and others have a touch of the "gorgeous East" about them, such being the ground-up pearl, which is administered as a powerful restorative to anyone at the point of death, and the powdered rubies and emeralds which are supposed to act as tonics.

If the Persian boy does not succumb to any illness he is taken from his mother at an early age, and handed over to the care of the servants, by whom he is trained to be an exact copy of his father.

No romping or running is allowed, such being considered undignified proceedings on the part of a gentleman, and the poor child is always treated as if he were grown up. He is made to sit still when with his elders, is dressed exactly like them in miniature, is instructed in an elaborate code of manners, and shares in the Persian dinner, which often begins at midnight.

No Persian of position ever sends his sons to school, but engages a priest to come daily to the house to teach them to read the Koran, Sadi, and Hafiz, and to instruct them in writing.

The education of the boys begins at five years of age; and if they decline to learn, two *ferashes*, kept in readiness outside the schoolroom door, are called in by the tutor to apply the *bastinado* to the soles of any unruly pupil. As the teacher is only paid about £1 a month, it is hardly to be expected that he can be a profound Arabic scholar, and the result of his training is that most boys can read the Koran glibly, but have not the least idea of its meaning.

As to general information, I hardly think that there is such a thing in Persia. One gentleman, who had been to England, told me that his priest had taught him that the Atlantic Ocean was a large city in France, and the rest of his instruction was on the same level.

Even when the boys are free of their tutor, they are placed under the care of a *lala*, an

old man who performs the functions of the Greek pedagogue, taking his charges out for walks, and keeping a keen eye on their movements.

This restricted life, so devoid of freedom and healthy exertion, has probably much to do with the poor physique of the upper classes, and helps to account for the enormous mortality among Persian children, it being stated that only two out of every six survive.

Europeans coming to Persia are often delighted with the finished manners of any little boy they may meet. A child of seven will receive them with the *aplomb* of a man of the world, ordering the servants to bring tea and sweetmeats, and entertaining his guests with conversation or with a recitation from some poet, but such accomplishments are acquired at a heavy cost.

Fathers often show but scanty affection for their children. One gentleman told me that his son was hardly more intelligent than an animal, because the youth could not master French. The young fellow did not resent this remark in the least. He said that he was his father's servant, and must submit to any kind of treatment from him, because his parent performed the seemingly obvious duties of feeding and clothing him. Another Persian described to me his home-coming from a successful career at the military college at Tehran. He hastened to greet his father, who sat surrounded by his servants, and hardly deigned to notice his son, telling him to retire at the end of a few moments. The young man was so overcome with mortification that he rushed from the room, and would have made away with himself had not an old retainer followed him and prevented the rash act.

Persian boys are instructed in the tenets of their religion by the priests, and though I am far from saying that there are no convinced Mohammedans in Persia, yet I only came across one in the upper classes, and was told more than once by acquaintances that they performed their devotions solely to impress the servants!

Almsgiving seems to be looked upon as a kind of insurance against the evils of this life. No Persian would think it quite safe to go on a journey without giving money to the poor, and if he were saved from any accident the numerous beggars would benefit, not so much from a sense of gratitude as from the idea of guarding against a future disaster.

Lying is looked upon as a fine art, and the man who takes another in successfully is applauded, while he who deceives clumsily is regarded as a fool. Patriotism and bravery are decidedly at a discount, and the youthful Persian of to-day is very unlike his ancestor as depicted by Herodotus. During my stay in Persia, I was often asked at what date the English army was to land on the shores of the Persian Gulf and proceed to take the country, this idea of a foreign occupation being highly approved by all.

On one occasion two officers, whom I knew, were discussing an expedition that they had undertaken against a turbulent nomad chieftain. A cloud of dust had been seen in the distance, and one of my acquaintances believing that the enemy was approaching in force, turned to fly, with all his soldiers following closely in his wake.

This incident was related by his brother officer to an amused group of Persians, and the narrator was not in the least abashed when his colleague turned the tables upon him with, "Yes, that was the time when you were so frightened that you stopped a riding-camel and crept into one of its saddle-bags!"

The point of the story was that the cloud of dust had been caused by a stampede of mares, and after the foregoing conversation, I was not surprised to hear that the nomad chieftain was still at large.

Time fails me, und I must not talk longer about Persian life, though I feel that I have only touched the fringe of my subject. I do not, however, wish to leave the impression that I take a gloomy view of the Persian character, for I confess to having a strong liking for the kindly, quick-witted, courteous sons of Iran. I have tried, as far as I have gone, to give a true picture of Persian upper-class life, and my paper is the result of over two years' residence in the country and somewhat unusual opportunities of mixing with its inhabitants. Yet, much as I sympathise with Persians, and grateful as I am for the unvarying kindness shown to me by high and low alike throughout my visit, it is almost impossible not to judge Orientals by a Western standard.

> "For East is East and West is West,
> And never the twain shall meet."

is a true saying, and it requires a penetration almost approaching to genius before a European can be quite fair to the Oriental point of view. There are such people as Orientalized Europeans, but they remind us of the Persian pro-

verb coined for such cases :—"The crow tried to walk like the pheasant, but he merely spoilt his own gait and became ridiculous for his pains."

DISCUSSION.

The CHAIRMAN thought those present would agree with him that they were deeply indebted to Miss Sykes for a most interesting and instructive paper. Although he had only been a casual visitor to Persia, he could more than endorse all she had said as to the fascination of its people and the country itself, and if anybody had the spare time he strongly advised them to make a trip to the country. It was rather a remarkable fact that of the authors who had written about the less well-known parts of Persia during the last quarter of a century, two of them, Mrs. Bishop and the reader of the paper, were ladies. The subject which Miss Sykes had chosen for the paper reminded him that there was no part of the world in which women had so great an advantage over men as in the East, where the domestic life of a large section of the inhabitants, at all events of the upper classes of society, was so strictly veiled from the gaze of all Europeans who did not happen to belong to the fair sex. He thought that that contrast, perhaps even more than any difference of race and religion, was what made the great gulf which existed between European and Western nations, to which Rudyard Kipling alluded in the lines quoted by Miss Sykes. For that reason he thought they were apt to forget that many such customs and habits were relics of a system which at one time was almost universal. Just as, for instance, the methods of Government which were very often called Turkish were, as every student knew, a survival of the old Byzantine system of Government, so many domestic customs in the East were very much what they were long before the tide of Arab invasion and conquest swept over the countries, and, unless they were assumed to be borrowed, at a very early period, they were not more distinctive of the East than of the West. Many of the characteristics mentioned by Miss Sykes, such as the prominent part assigned to slaves in the education of youths and the intimate relations which subsisted between servants and masters in Persia, were quite as familiar traits in the ancient life of classical Rome and Athens. Many of the superstitions mentioned, such as the ill-omened importance attached to the act of sneezing, and the evil-eye, which he supposed was the explanation of the importance attached to the first person's face one saw on waking—unless he happened to be an executioner, in which case there was a more obvious explanation ; both these superstitions were familiar among the lower classes on the continents of Europe at the present moment. As for the Persians, belief that spectres and bogies would not reveal themselves to unbelievers, that was a conviction which, if it could only be imparted to the members of the Psychical Society, would save them a considerable amount of trouble. Taking another point mentioned, the indulgence with which the Persian regarded the art of ingenious deception—which in this country was called by the more polite phrase of diplomacy—the most consummate master of that art, who was for ever held up to posterity for emulation, was a Greek and was portrayed by an ancient Greek poet. In connection with the status and position of women in the East, it must be remembered that polygamy had practically ceased in the West long before the Roman empire came to a close, and when we prided ourselves upon our liberal ideas with regard to women at the present time, he thought we ought to remember there was a period of time during the Middle Ages when the position of women was far less free than it was in the later days of that empire. Again, in the East, the practice of seclusion had certainly continued uninterruptedly from a period a great deal anterior to the reign of King Darius ; and at the present moment the practice in the East, that a man never saw his wife until after he had married her, was just as common among the Nestorian Christian tribes, among whom he had travelled, as among the upper classes of society in Kerman. On the other hand, he disagreed with Miss Sykes in her statement that the tendency towards the adoption of monogamy in Eastern countries at the present day, as much among the richer classes as among the poorer classes, was to be attributed entirely to the prudential motives dictated by poverty. He strongly suspected that the adoption of monogamy in the East, as in the West, was very largely due to motives of practical convenience. As nations adopted monogamous customs so they abandoned the system of seclusion, because if a man had only one wife he wanted her to be more of a companion and more intellectually trained, and an educational system did not flourish under the system of seclusion. If that was the case, one might expect to find in times to come, in countries like Persia, that female seclusion would more and more be abandoned, and perhaps even the proverbial unchangeability of the East might alter when they allowed freer scope to what was, he thought, admittedly the more inquisitive and changeable of the sexes. That was a line of investigation which, however interesting in itself, was perhaps hardly profitable to pursue on the present occasion, but he hoped before the discussion concluded, the audience would have the advantage of hearing more details with regard to the domestic life of Persia, modern and ancient, from those who had made a special study of the subject, and who had travelled more widely in the country than he had himself.

Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., said he was greatly honoured in being called upon to move the

vote of thanks to Miss Sykes; and he only wished the duty had been entrusted to some one who would have discharged it in a manner more worthy, than was possible in his case, of the valuable paper that had just been read to them, and its distinguished authoress. The paper was unusually instructive, for, as the Chairman had said, it presented them with many quite novel scenes of Persian life, owing to the privilege that had been so courteously and freely extened to Miss Sykes of admission to the secluded society of Persian ladies of the highest birth and position. The paper was also one of marked merit on account of Miss Sykes's clear and comprehensive grasp of her subject, and the intuitive sympathy with which she treated it in all its aspects and phases; and, again, for the ease, with which,—using the simplest words,—she had conjured up so a vivid picture of each of the scenes in succession described by her. Her brother, Major Sykes, was the most scholarly explorer of Persia they had ever sent into that country; where from the head of the Persian Gulf down to Bunder Abas the secrets of the very beginnings of the civilisation of Anterior and Southern Asia have yet to be unearthed. He had rendered invaluable services to his countrymen in these researches, so far as he had already dealt with them; and it was evident that Miss Sykes was herself endowed with a full share of the family ability, courage, and graciousness, which had made her brother so successful a traveller. There was really nothing to criticise in a stringent spirit in the paper. By a slip of the pen Miss Sykes had qualified Friday as one of the unlucky days of the Mahometans of Persia. This must be corrected, for Friday is the luckiest, if only because the holiest day of the Mahometan week. Everywhere the Mahometan auspicious days were Monday, Wednesday, Thursday, and Friday; while Sunday, Tuesday, and Saturday were inauspicious; Saturday and Sunday being particularly unlucky, and altogether evil. This attribution of good and ill-luck to certain days goes back to the very earliest known civilisations of the Old World; while the interchange of luck between the days of the week is due to the secular reaction of Eastern Paganism, Judaism, Western Paganism, Christianity, and (the religion of) Islam on one another. The week (*i.e.*, "turn") of seven days originated in archaic Mesopotamia with the worship of the seven planets; and the general luck of each day of 24 hours was determined by the character of the planet to which it was—from that planet falling on its first hour—consecrated as a complete day. In the seven staged planetary temples of Babylonia, Assyria, and Media [Ecbatana], and among the Paropamisadae [Ghazni], as also far later [A.D. 420] in the palatine temple of Varahran V, the 1st or ground stage was consecrated to the planet the Romans called Saturn, the planet farthest from the earth, and of the greatest orbit, the 2nd to Jupiter, the 3rd to Mars, the 4th to Sol, the 5th to Venus, the 6th to Mercury, and the 7th to Luna. But the Babylonians and Assyrians, &c., did not count the days of the week in the order of the stages of these planetary temples; that is Saturday, Thursday [Jove-Thor], Tuesday [Mars-Tuisco], Sunday, Friday [Venus-Friya, compare *fri*-end], Wednesday [Mercury-Woden] and Monday; but counted them Saturday, Sunday, Monday, Tuesday, Wednesday, Thursday, and Friday. The true reason, as he found in Bombay [for the Pythagorean Greeks explained it by some hypothesis of mystic "quarternions"] was that, not only each day of the week, but each hour of every day of twenty-four hours, was consecrated to one or other of the seven planets. Beginning with Saturday, the 1st hour was consecrated to Saturn, and the 8th, 15th, and 22nd hours. The 23rd hour was sacred to Jupiter, and the 24th to Mars. The hour following was the first hour of the next day, and Sol falling in his turn on that hour, the whole day was consecrated to Sol, and called Sunday. For the like reason the following day was called Monday; and so on through Tuesday, Wednesday, and Thursday, to Friday. Friday was sacred to Ishtar [Astoreth, Astarte, Aphrodite, Venus, Friya], and was the Sabbath [*i.e.* "rest"] of the Babylonians and Assyrians, and wholly given up to pleasure and dissipation. The Hebrews, to differentiate themselves from the surrounding Gentiles, made Saturday their Sabbath; and again the Christians, in a similar spirit, changed it to Sunday; which, in celebration of the Resurrection, they called "the Lord's Day." Friday they made an especially unlucky day, and not only because of its dissolute associations, but because the Crucifixion is recorded to have been on that day, and because it is said Eve eat "the forbidden fruit" on that day, and died on that day. We say "Black Friday" simply because the Pretender reached Derby on that day, December 6th, 1745. Mahomet, however, went back to the immemorial Sabbath of Anterior Asia, but he made it not a popular ritualistic festival, but a day of the most solemn dedication and consecration of the Believer to Almighty God. The propagation of the Mesopotamian week, and of the Latinised names of its days, over Europe, was a very slow process. It began possibly 2000 B.C., and it was not completed in France, Germany and Britain until about the 8th century; and that was the reason of the contradictions existing in Western and Northern Europe as to lucky and unlucky days. The Greeks early recognised the *hebdomas* (*i.e.*, "septenary") of Anterior Asia, but never, until Christian times, adopted the planetary names of the week. In Rome, also the "hebdomas" superseded the "nundinæ" (*i.e.*, "nine days") long before the Romans named the days after the seven planets. This began in the time of Julius Cæsar, and was completed by the time of Valentinian [*see* Ausonius, Eclogues, "De nominibus Septem Dierum," Amsterdam, 1671, pp. 550-52]. This gradual transfer accounts for such facts as that in Scotland Friday is still a most lucky day for marriages: and that in America also Friday is still largely regarded as a lucky day. There is a North of England doggerel, probably known both to the Chairman and Miss Sykes, which strangely mixes up

the Christian and Pagan luck of the days of the week:—

> "Monday's bairn is fair of face,
> Tuesday's bairn is full of grace,
> Wednesday's bairn is full of woe,
> Thursday's bairn has far to go,
> Friday's bairn is loving* and giving,
> Saturday's bairn works hard for a living.
> But the bairn that is born on the Sabbath Day
> Is happy, and bonny, and wise, and gay."

There were one or two other very minor points on which he might say more had he not already said so much about the days of the week. He did not quite agree with Miss Sykes' animadversions on the Mohametan law of divorce. Its spirit, at least, is most compassionate, and in its operation it at least avoids all scandal; while from Miss Sykes's own paper it is clear that the Persians treat their wives most lavishly to the best of their earthly possessions, cool rooms, exquisite carpets and hangings, tasteful furniture, the daintiest of meats, really refreshing "teetotal drinks," and those gardens of delight from which all the world derives the name of "Paradise." Again, as between the Chairman and Miss Sykes, he held that the movement towards monogamy in Persia is largely due to economical causes. He knew that the tendency toward Agnosticism in India is. To be a thoroughly good Hindu, costs much. It also costs something to be a consistent Christian, or a Muslim. It is offensive to a Muslim to call him a *Mahometan*. It ascribes divinity to Mahomet. Agnosticism, as a distinguished Hindu Agnostic told him some years ago, "costs nothing." The "Protestant Reformation" was largely due to economic measures. But these were matters not directly connected with the paper, the reading of which had been in every way, in its matter and its literary form, and in the very manner of its delivery, a brilliant success. He most cordially moved the thanks of the meeting to Miss Sykes.

Mr. Edward Penton, Junr., in seconding the vote of thanks, said that Miss Sykes had given a description of what no male traveller in Persia could ever possibly enjoy, namely, a peep into the *Anderoons*. The careful way in which she had worked out the domestic life of the country was most interesting. Persia at the present moment was a much discussed country, mostly through the medium of the Press, but he thought few people took the trouble to study its domestic life. A traveller in Persia missed nothing so much as the faces of women; he went through a Persian town and saw what looked like little bundles on legs running through the streets. The veils the women wore might cover the most beautiful faces in the world, but the traveller could never possibly know. Miss Sykes had seen behind the veil, and probably would be able to say whether their conjectures were correct or not. In regard to the pilgrimages, he had joined the road to Meshed at Tarbat-i-Haidin, which might be called the "Clapham Junction" for Meshed, and the number of women setting out for the pilgrimage was simply extraordinary. Throughout the journey of about 90 miles the women were housed in most uncomfortable places, sleeping in stone rooms, with a mat placed in front of the door, and with a chance of being kept awake all night by the chatting of the muleteers, which never ceased. Miss Sykes had not alluded to the great use of opium, which it appeared to him must conduce a great deal to the laziness which was evident throughout the Eastern portions of Persia.

Surgeon Lieut.-Col. Ince asked Miss Sykes in her reply to say whether, when she visited the zenanas, she went, as most English ladies did, open-faced or whether she wore a veil.

Mr. J. D. Rees, C.I.E., said that Mr. Savage Landor, in his recently-published book, "Across Coveted Lands," dwelt repeatedly on the great rudeness of the Persians. His own experience was very different, and he would like to have Miss Sykes's opinion on the subject. He would also like to ask her whether she ever came across the robbers who figured so frequently in many travellers' experiences, but of whom he saw absolutely nothing in the most robber-ridden province in Persia, viz., Kurdistan.

Miss Sykes, in reply, said that she had resided in Persia for nearly two and a-half years, and during the whole of that time she went about as an Englishwoman, with an unveiled face, even when she visited the *Anderoons* to see the women. She had always met with unfailing kindness and courtesy throughout the country. The Persians were very like the French, they had particularly good manners themselves, but naturally would easily be ruffled if not treated with courtesy. She had not yet read Mr. Savage Landor's book, and did not know where he had met the robbers; she had never come across robbers herself during her travels through Persia, but the fact of her being in the company of her brother, who was a British Consul, might have accounted for the immunity. She had, however, met a good many people who had been in Persia, and had heard from them that it was on the whole the safest country in the East in which to travel.

The vote of thanks having been carried unanimously, the meeting terminated.

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* Friya is the Goddess of Love. The Mahometans also, at least, of India confuse the luck of the days of the week by, in counting the days of the month on their fingers, holding the days which fall on the middle finger ["digitus infamis," "d. sceleratus," &c.], *i.e.* the 3rd, 8th, 13th, 18th, 23rd, and 28th, unlucky.

CANTOR LECTURES.

"THE FUTURE OF COAL GAS AND ALLIED ILLUMINANTS."

By Professor Vivian B. Lewes,
Royal Naval College, Greenwich.

Lecture I.—Delivered Nov. 24th, 1902.

Few of the great industries have undergone such radical changes in condition as have fallen to the lot of gas manufacture during the past twenty years, and my desire in these lectures is to show how these changes have arisen and the direction in which they tend, together with such side issues as must of necessity be satisfactorily settled before the altered condition can bear full fruit for the consumer of gas, and before the gas manager can give his full adhesion to the altered state of things.

When, in the early years of last century, coal gas became a commercial reality, the one end and aim of the manufacturer was to produce his gas, and such details as purity, illuminating and calorific value, never troubled his mind. As time passed on, however, and competing companies vied with each other in their endeavour to secure customers, advantages had to be offered to coax consumers from the enemy's camp, and those who remember the battle of the two then existing City companies with another proposed rival in 1847-48-49, and the way in which the gas consumers in the City were at that time pestered and pamphletted by the supporters of the rival schemes, will realise that even in those days gas management was not a bed of roses. The outcome of the rivalry was the introduction in the early fifties of a standard of illuminating value and a string of Parliamentary requirements which have ever since safeguarded the consumer and harried the gas manufacturer.

In 1850 a Bill was passed which enacted that a consumption of 5 cubic feet of gas per hour should be equal to the light of 12 wax candles of the size known as sixes, the burner employed being a brass argand burner with 15 holes. In 1860 another Act changed the illuminating power to 12 sperm candles, which meant an increase of some 16½ per cent. in the illuminating value of the gas, owing to the fact that the wax candles originally used were only equal in illuminating power to 10·3 sperm candles as at present employed for testing purposes. In 1868 the illuminating power was again raised to 14 candles, whilst, in 1876, the present 16 candle standard was reached.

The amount of light emitted by the gas, however, was still insufficient to satisfy the desires of the consumers, who, utterly ignoring the fact that the illumination to be derived from coal gas was quite as much dependent on the burners employed as it was upon the standard illuminating value, vented their dissatisfaction at the light emitted by small flat-flame burners by clamouring for a higher quality of gas; and even thirty years ago the great aim of the gas-consuming public was to obtain the highest candle-power gas that could be squeezed out of the gas company, in order that they might gain something like decent illumination from the flat-flame burners then almost exclusively used, and which were as a rule so small as entirely to destroy the value of the gas. It was at this period that the anomaly became common of seeing a town supplied with gas of over 20 candle illuminating value, swathed in semi-darkness, whilst another, with the much abused 13 or 14 candle gas, supplied at a good pressure and burnt in decent sized burners, was well illuminated.

It was at this time also that some of our most able chemists ranged themselves on the side of the votaries of high illuminating power, and even such practically-minded men as the late Sir Edward Frankland clamoured for the introduction of high illuminating power gas, such as is produced from cannel, in place of 16-candle coal gas, the general line of argument being well shown by portions of Sir Edward Frankland's introduction to the section of his published researches dealing with applied chemistry, in which such paragraphs as the following occur:—

> "Coal gas is not suitable for use in dwelling-houses by reason of its very low illuminating power—100 cubic feet of coal gas contain only 4 cubic feet of illuminating gas, the rest is mere rubbish, which heats and pollutes the air in which the gas is consumed. . . . . . It cannot be too widely known that coal gas, although it costs less per 1,000 cubic feet, is light for light much dearer than cannel gas."*

Even now, when altered circumstances make a high power gas an anything but desirable and economical supply, there are not wanting advocates who, undaunted or perhaps ignorant of the practical side of the question, still try to bolster up the old idea.

It was in the latter part of the eighties that the lot of the worried manager was made even harder by the rise in price taking place in

* Frankland's "Experimental Researches in Pure, Applied, and Physical Chemistry, 1877," p. 488.

cannel coal, on which up to that time he had entirely relied in admixture with ordinary gas coal to give those higher grades of illumination demanded by the fashion of the time, and which, although it ruined his coke, yet proved an efficient and reliable servant.

This increase in price became so serious that in 1889 the Gas Light and Coke Company commenced experiments which led to the introduction of carburetted water gas in place of cannel as an enricher, this process proving itself a most valuable addition to the manufacture of coal gas, and rapidly gaining favour and popularity not only as giving an easy means of raising the candle power of poor gas, but also as a standby in case of any sudden calls upon the production power of the works.

About this same period also another method of enrichment was introduced which consisted of adding to gas which did not fulfil the Parliamentary requirements the vapours of such highly volatile hydrocarbons as petroleum spirit and benzol, which on account of their high illuminating value gave the necessary increase in the candle power by the addition of an amount of vapour not likely afterwards to recondense from the gas.

Whilst these changes were taking place in gas manufacture rivals which seemed to threaten its very existence had forced their way to the front, and with the electric light largely used by the rich, and petroleum reduced to a price at which even the poorest could afford its use as an illuminant, the field of utility seemed to be rapidly disappearing from beneath the feet of the gas industry. However, when things were looking their blackest there slowly struggled into prominence and commercial success a factor which at once restored gas to its position of primary importance.

It was in 1885 that the researches of Dr. Auer von Welsbach culminated in the production of the incandescent mantle, which, frail and unsatisfactory in its earlier forms, was gradually so improved in composition and manufacture that by 1892 it became a brilliant commercial success, and placed in the hands of the gas industry a weapon which rendered their position unassailable in competition with electricity.

Looked at from a common-sense point of view, the incandescent mantle will be seen to be merely a method of enrichment. Instead of increasing the illuminating power of a flame by crowding into the gas more and more hydrocarbons, which during combustion are capable of separating carbon particles, the incandescence of which would increase the amount of light emitted by the flame, and *pro rata* the amount of heating, with the mantle you charge the flame with incombustible particles of far greater light emissivity than the carbon possesses, and they do their work without that increase in the temperature of the atmosphere inseparable from the other processes. It is therefore the introduction of the incandescent mantle and the improvements which are possible in its construction which really give the possibilities to the gas of the future.

Taking now the enriched, or, as some prefer to call it, adulterated 16-candle gas as supplied during the nineties, the light which can be obtained from it is entirely dependent upon the burner in which it is consumed. This may be stated as follows :—

LIGHT EMITTED PER CUBIC FOOT OF 16 CANDLE GAS CONSUMED.

Burner.	Candle units.
Incandescent (high pressure)	30-35
,, (Kern)	20-25
,, (ordinary)	14-19
Regenerative	7-10
Standard Argand	3·20
Ordinary Argand	2·90
Union jet flat flame, No. 7	2·44
,, ,, ,, 6	2·15
,, ,, ,, 5	1·87
,, ,, ,, 4	1·74
,, ,, ,, 3	1·63
,, ,, ,, 2	1·22
,, ,, ,, 1	0·85
,, ,, ,, 0	0·59

In considering the value given to the gas by these burners, it is seen that, according to the method by which it is burnt, the consumer may obtain anything from 35 candles down to less than one candle per cubic foot of gas. It must also be borne in mind that the burners employed in these tests were all good, well-made burners, giving the best duty that can be obtained from them, whilst an examination of the burners used in consumers' houses shows that in most cases any antiquated and corroded burner is considered good enough at which to burn the gas, and the very people who are loudest in their complaints as to the quality of the gas are those who most disregard the method of its consumption.

Sir George Livesey, in 1900, pointed out that in fifty cases of complaining customers he had the old burners removed and replaced by new ones, when the complaints at once ceased, and on testing the burners so removed it was clear

that the trouble had been caused entirely by their condition being absolutely unfit for the consumption of illuminating gas. In another case, under my own observation, thirty flat-flame burners were collected at random from houses of consumers supplied with the town gas. They were mostly union jet burners, Nos. 3 to 7, and were tested first when consuming 20-candle gas and subsequently with London gas.

With the 20-candle gas the best consumers' burners gave 14·08 candles per 5 cubic foot rate, and the worst gave 4·34 candles. Of the total number of burners 30 per cent. gave less than 7 candles per 5 cubic foot rate, and the average of the whole number made the illuminating value of the gas 8·5 candles.

With London gas, the best burner gave 10·6 candles per 5 cubic foot rate, and the worst 3·1 candles. Fifty-six per cent. of the total number gave less that 7 candles per 5 cubic foot rate.

The actual consumption of the burners when supplied with gas under $1\frac{1}{2}$ inches pressure varied from 4·5 to 5 cubic feet per hour, and the consumptions were the same with both kinds of gas.

England is far behind Germany in the use of incandescent lighting, and an inquiry made this spring into the uses to which the coal gas supply of a large town was put, gave the following result:—

Incandescent lighting (private)	12·00	per cent.
,, ,, (public).	6·25	,,
Cooking	23·75	,,
Gas engines	6·60	,,
Used in other ways	52·50	,,
	100·00	

So that 47·5 per cent. is used for purposes in which illuminating power is of no use, and calorific effect is the one important factor.

It is also seen that 18·25 per cent. of the total gas made is used for incandescent lighting, and this represents about 23 per cent. of the gas used for illuminating purposes, as against 90 per cent. used in this way in Germany.

This 23 per cent. thus used gives for a consumption of 5 cubic feet not less than 70 candles, whilst the average light obtained by the combustion of the remaining 77 per cent. is 8·5 candles.

It is quite clear that under such conditions as these the supply of gas of a high candle power is simple waste of money, and it is manifestly unfair that the consumer of average intelligence, who is willing to utilise the benefits given by the incandescent mantle, should have to pay for a quality of gas only rendered necessary by the inertia of those who decline to march with the times.

For many years, I have felt and pointed out that the consumer, knowing only that he wants more light, and absolutely ignorant of the principles of gas lighting, clamours for a richer gas, whilst the remedy is all the time in his own hands, and the only thing he has to do to attain his desire is to employ rational burners. Men like Sir George Livesey, Mr. Foulis, and Mr. Webber, have long since seen the fallacy of high candle power gas, and have fearlessly denounced it, and the time has now come when the principle is being widely grasped, and manufacturer and consumer alike are realising that cheap gas, and plenty of it, gives far greater possibilities and better illumination than high illuminating value gas which must of necessity cost more, as in trying to economise by using small burners, the light-giving value is destroyed to such an extent that the effect produced is utterly inadequate to the cost.

The arguments brought forward in favour of high power gas, and its advantages over low grade gas, are, as they always have been, that for a given illumination it is cheaper, fouls the air of a room to a smaller extent, and does not for an equal illumination give as much heat. These contentions were to a great extent fallacious, even under the old conditions, as although a 22 candle cannel gas gives 4·4 candles per foot when burnt in a standard flat-flame burner, as against the 3·2 yielded by the 16 candle gas burnt in the London argand, directly they came to be used under ordinary consumers' conditions there was little to choose between them, whilst any coign of vantage that cannel gas had entirely disappears under the conditions which now dominate the gas industry, and it is just Sir Edward Frankland's 96 feet of rubbish which makes the gas of the future.

Two years ago Mr. Webber gave a most interesting lecture before the Gas Institute, taking as a title "The New Gas," which turned out to be the low grade gas so widely used with incandescent mantles and for fuel purposes on the Continent, and pointed out that, freed from the trammels created by the Welsbach monopoly in this country, incandescent lighting in Germany had almost displaced all other forms of gas burning. There is not the least doubt that, with improvements and

cheapening in the production of mantles, the use of coal gas in this way would rapidly rise in this country to the same dimensions as on the Continent.

It will be well at this point to consider the conditions under which the gas manufacture at present labours, and the ground it must cover in the future, if it is to hold its own.

We have not heard so much of late of the working out of our coal supplies, but the fact remains that the best seams of gas coal are getting used up, and coal of this class will soon show an increase in price that will prevent any high quality of gas being made direct from it without a commensurate rise in the price of gas. All enriching materials, moreover, fluctuate in price with the demand made upon them, so that if the high illuminating value of coal-gas is to be maintained, the probabilities all point to a rise rather than a diminution in price; and even in calculating the probable saving to be obtained by the introduction of gas of lower illuminating power, this factor ought to be taken into consideration.

A 16-candle coal gas when consumed with the incandescent mantle may mean an 80 to 100 candle gas, and the difference with properly regulated air supply to the burners between a 16 and a 14 candle gas is so slight as to be undistinguishable to the eye, whilst the diminution in heating power which accompanies the lowering of the illuminating power, although not sufficient to make a large difference to the gas for fuel purposes, yet adds to one's comfort in a dwelling room, where as a rule the ventilation is none too good.

Coal gas is daily being used more and more as a fuel, and, although the slight diminution of calorific value which must of necessity accompany a lowered illuminating value is a slight drawback, yet in practice any desired temperature can be attained by a slightly larger consumption. Also a cheapening of the gas would induce many to adopt it as a fuel, this in turn tending to level up the load in production, and so render more economies possible.

Everything clearly points in one direction, and that is that the future of coal gas is entirely dependent upon a plentiful supply of low grade gas—low grade from the point of view that it shall only have an illuminating value of 10 to 12 candles, that its heating value shall be as high as can be practically attained, and that its price shall be as low as is consistent with the interests of the consumers as well as of the shareholders in the gas industry.

Already the stream has set in in this direction, and the lowering of the Parliamentary standard of 16 to 14 candle-power in the case of the South Metropolitan, and Commercial, and West Ham Gas Companies will soon be followed by many companies now saddled with a higher standard than 14 candles. That relief cannot be in fairness refused, whilst experience of the benefits conferred by the reduction will soon lead to the further step that will place gas manufacture in this country on the same advanced footing that already it has gained in the most progressive cities in Germany.

When, however, the change from a 16 or higher candle power down to a 14 or lower illuminating value has been sanctioned by Parliament, the gas manager finds himself confronted with the difficulty that his works have been erected and adapted for making the higher value, and all his practical knowledge is in that direction. His first trouble is to find out how this grave problem is to be overcome, and how the low grade gas can be most economically and best produced, and it is with the solution of this question that I now desire to deal.

In order to find an answer which will be of practical use it is no good advancing theories and proposing methods which necessitate such wholesale alterations in plant and procedure as would to all intents and purposes mean scrapping the existing generating machinery. The only processes which have a chance of being adopted must be very much on the lines of the old process, and if the plant be altered at all the alteration must be such as can be made at a reasonable outlay and without serious disturbance to the ordinary working. The gas which is produced must be in all save illuminating value of the same character as the coal gas, of which we know the behaviour, and for the consumption of which our stoves and burners have been constructed, special attention being paid to keeping up the calorific value and keeping down the cost.

The logical method of arriving at our result is first to see the composition which would yield ideal results, and then to see what process can be utilised in attaining the nearest approach to this. In order to do this, the first point is the effect of the constituents of gas on the results to be obtained from it.

The great advantages possessed by coal gas over the fuel gases properly so called—water gas, Siemens's gas, and the hundred and one modifications of them which have been more or less used, consist in the presence

of those compounds that we call hydro-carbons; and first and foremost both in giving size and heating power to the flame, as well as helping its luminosity, stands methane (CH_4)—a gas which at various periods in its career has been better known as marsh gas or light carburetted hydrogen. A natural product of the decompositions which led to the formation of coal from the monster vegetation of pre-historic times, its presence ready formed in the coal measures has proved one of the greatest dangers that the winners of our fuel have had to contend with; as mixed with the air in the workings of a mine it forms the dread fire-damp that has cost us so many lives.

Taking the average composition of an ordinary 16 candle coal gas, free from enrichment, we may state it as follows:—

Hydrogen	54·0
Methane and hydrocarbons of the same character	34·0
Ethylene and hydrocarbons of the same character	3·0
Benzene	1·0
Carbon monoxide	6·0
Nitrogen	2·0
	100·0

All of these, with the exception of the nitrogen, contribute their quota to the heating value of the gas, and their relative value in this direction may be stated as follows:—

Gas.	Gross.	Nett.	Illuminating Value per 5 cubic feet.	B.T.U.'s per Candle.
Hydrogen	325	272	—	—
Methane	1,024	919	5·2	312·5
Ethylene	1,603	1,510	70·0	114·5
Benzene (vapour)	3,718	3,574	820·0	22·6
Carbon monoxide	330	330	—	—

Applying these thermal values to our coal gas, we obtain:—

Hydrogen	54 × 325 =	17,550
Methane	34 × 1,024 =	34,816
Ethylene	3 × 1,603 =	4,809
Benzene	1 × 3,718 =	3,718
Carbon monoxide	6 × 330 =	1,980
		62,873

or 628·73 B.T.U.'s gross for a cubic foot, which experience tells us is about the value given by the calorimeter.

It is clear from this that more than one-half of the calorific value of our coal gas is due to methane, and more than two-thirds to the mixed hydrocarbons, and it is evident that these heat-yielding bodies must be fully represented in our future gas.

The only commercial and attainable sources of such hydrocarbons are found in the destructive distillation of coal and mineral oils; and although the hydrocarbon gases *per se* could probably be obtained most cheaply by the cracking of mineral oils, yet we should then be driven back for the large volume of diluting gas, which would be a necessity to lower the illuminating power and cost, to water gas, which under these circumstances would be the only available diluent. At once, however, three factors crop up which would immediately negative the use of a low grade carburetted water gas, and these are (1) that it would forthwith render useless the existing gas plant, (2) that cheap coke being an essential to the manufacture of water gas, the cutting off of the supply of this material would at once render the manufacture of water gas an impossibility at a commercial price, and (3) that blue water gas contains 40 per cent. of carbon monoxide, and that although in a 20 candle-power carburetted water gas this is reduced to 30 per cent., yet in a 12 candle-power mixture it would rise to 35 or 36 per cent., which under existing circumstances would never be permitted for a domestic supply.

In order to make our view of the subject as complete as possible, I shall deal later on with the economic side of a gas supply made on these lines, but I have thought it best to state at this point, in a few words, my reasons for considering that it never would be adopted. It is evident, therefore, that coal and not oil must be the main factor in producing those hydrocarbons which are to raise the calorific value of the gas to the required point, and we can now discuss the methods by which increased volume and lowered cost can be obtained on this basis.

Amongst the suggestions made for cheapening the manufacture of gas at the expense of illuminating value, is that higher temperatures should be employed for retorting the coals, but I think the majority of gas managers will agree with me that the useful maximum temperature has been attained, and that a further pushing of the heats would accentuate troubles which have already shown themselves.

If the present practice of using temperatures that yield about 10,000 cubic feet per ton of coal were departed from, the first thing that would make itself felt is the fact that only a small portion of the gas coal supply is fitted for use at higher temperatures than those em-

ployed, and this limitation would soon tend to raise the price of such kinds of coal as could be used.

In a highly suggestive paper read by Mr. Harry E. Jones, this year, on the "Illuminating Power of the Gas of the Future," experiments seem to show that with a Durham coal it is possible to increase the yield of gas per ton of coal by something like 25 per cent., with a total increase in calorific value, by increasing the temperature of carbonisation and diminishing the pressure in the retort. Working in the same way, I have found results of the same character, but it must be borne in mind that this only means an increase in the volume of gas obtained per ton of coal from 1,000 to 1,250 feet.

The most complete work ever done on the distillation of coal was by Mr. Lewis T. Wright, and the paper which he read at the May meeting of the Incorporated Institute of Gas Engineers in 1895, will long remain one of the most valuable contributions to the subject of carbonisation. In it he showed that by pushing the temperature at which distillation was taking place, a rise in volume yielded per ton of a Derbyshire caking coal took place with increased heats, till a maximum of 12,190 cubic feet per ton was reached, and this gradually fell again, the same thing being observed with other coals. It seems highly probable that the conclusion is correct that the more rapid distillation due to pushing the temperature in the retorts would not be attended by any very marked increase in the yield of gas per ton, as the more rapid evolution of gas in the early stages of the charge would hurry the gases out of the retort, and so prevent their being broken up by the increased temperature. Indeed, on purely theoretical grounds, it is impossible for increased temperatures to give more than a certain increase in volume, as the chief constituents once formed in the retort, they are so stable with regard to heat, owing to their character and to dilution, that but little extra gas is obtained from them, whilst in baking the already-formed gas, it is only the higher hydrocarbons that by their decomposition can give an increase; further, whilst some of these are being decomposed to carbon and hydrogen, others are being synthetically built up into such bodies as naphthalene.

In a recent experiment made under my direction a poor coal was retorted at the usual temperature, and after the candle power and calorific value had been determined, samples were taken for analysis. The temperature of the retorts was then raised as high as they could be got, and fresh determinations made with the following results :—

	I. Ordinary Temperature.	II. High Temperature.
Hydrogen	51·11	54·68
Saturated hydrocarbons	36·39	32·32
Unsaturated hydrocarbons	4·50	4·00
Carbon monoxide	7·00	7·00
Carbon dioxide	Nil	Nil
Oxygen	Nil	Nil
Nitrogen	1·00	2·00
	100·00	100·00

	Illuminating value.	Calorific value, B.T.U.'s Gross.	Nett.
I.	15·2	612	556
II.	14·6	596	532

Showing that the action taking place was an increase in the volume of hydrogen at the expense of the hydrocarbons present, and where it has been possible further to increase the temperature of carbonisation the action has been still more marked.

If instead of taking a poor coal, as was done in this case, and using the ordinary retort temperature, which gives in the first case a large amount of hydrogen in the gas, a rich Newcastle coal is taken and is retorted first at a low temperature (dull red), and is then carbonised at the highest obtainable temperature (bright orange), this action is still more striking. As far back as 1884 Mr. Lewis T. Wright made an experiment of this character with the following results :—

	Temperature. I. Dull red.	Temperature. II. Bright orange.
Hydrogen	38·09	48·02
Saturated hydrocarbons	42·72	30·70
Unsaturated hydrocarbons	7·55	4·51
Carbon monoxide	8·72	13·96
Nitrogen	2·92	2·81
	100·00	100·00

	Illuminating value.	Cubic feet per ton.	Calorific value, B.T.U.'s calculated.
I.	20·5	8250	811·0
II.	15·6	12006	588·8

and it is here again evident that the breaking down of the hydrocarbons into hydrogen and carbon has given the increase in volume, and whilst there has been an increase in the candles per ton of coal carbonised, amounting to 10·3 per cent., the increase in calorific value per ton is only 5·6 per cent.

A large increase of temperature above that at present employed would, moreover, result in such trouble from stoppage of ascension pipes from pitch, and from naphthalene in the service pipes and mains, not to mention the increased quantity of sulphur compounds, and the reduction in ammonia and tar, that leaving out the question of wear and tear and fuel, such a method of increasing the yield could never be successful.

There is, however, another phase of the question, and that is by employing inferior coal bought at a cheaper rate, and retorting it at the highest temperatures found compatible with economical working, the low grade of gas of good calorific value might be obtained direct, but the economy to be attained would be very small,

The method, however, of obtaining a low grade gas which would be most welcome to the gas manager, and would comply with the necessities of the future, would be in no way to alter the working or arrangement of the present plant, to make the same gas as heretofore, and to dilute it down to the required point by a combustible diluent which must be cheap enough to offer sound economical advantages, and yet of sufficient calorific value to keep up the heating power of the mixture to the needed point.

The only gaseous mixtures which are available for this purpose are either water gas pure and simple, or mixtures containing water gas as their basis, and a glance at the calorific values of the so-called fuel gases makes this at once apparent.

Water gas	328 gross
Producer gas	79 ,,
Dowson gas	150 ,,
Mond gas	155 ,,

Indeed with the exception of water gas the so-called fuel gases, containing about two-thirds of their volume of inert nitrogen, and being of high specific gravity as compared with coal gas, do not lend themselves to distribution.

Blue water gas, as it is customary to call the non-luminous mixture of hydrogen and carbon monoxide generated by the action of steam or incandescent carbon, first made its appearance in this country on a manufacturing scale in 1887-8 as a fuel where high local temperatures were necessary, and shortly afterwards carburetted water gas, a mixture of water and oil gas, was introduced at Beckton as an enricher of coal gas in the place of cannel coal which had, at that time, risen to prohibitive prices. The ease and rapidity of manufacture at once secured it a complete success, and at the present time very few large gas works are without this valuable auxiliary.

The attitude of the public towards this new introduction was at first one of apathy, but presently the gentlemen who delight in writing to the daily papers and seeing their names in print recognised a golden opportunity for self advertisement, and the public were informed that death and every form of horror were being let loose upon them. The exaggerated and mostly false statements of the early agitators being to an extent supported by well-known and well-meaning medical practitioners, who had plenty of book-lore and little or no experience of the subject, a crusade against water gas was started, which culminated, in 1898, in the appointment of a Departmental Committee to inquire into the subject. Their report was issued in 1899, and it is probable that some legislation on the subject will shortly be brought forward.

Now the facts with regard to water gas are these. Made by passing steam over incandescent coke or anthracite, it has an average composition—

Hydrogen	52
Carbon monoxide	38
Carbon dioxide	5
Oxygen	1
Nitrogen	4
	100

and it is the 38 per cent. of carbon monoxide that has roused the storm of angry criticism.

Carbon monoxide, or carbonic oxide, the name by which it used to be more generally known, is a virulent poison, and when inhaled in even small quantity causes death, by combining with the blood and gradually cutting off the oxygen normally supplied to the body by the blood.

0·4 per cent. of carbon monoxide in the air

will produce death if inhaled for over an hour, whilst 0·05 in the air will only cause headache and giddiness however long the mixture may be inhaled. So that air containing 4 parts in a thousand is fatally poisonous, and air containing less than 5 parts in ten thousand is practically harmless.

Now this sounds alarming enough, and bears out the contentions of the opponents of water gas, but the points overlooked by them are that in an ordinary sized room it is very difficult even purposely to make a fatally poisonous mixture of air and gas, and, secondly, that blue-water gas with its 38 per cent. of carbon monoxide is not distributed as a domestic supply.

In order to give luminosity the otherwise non-luminous water gas is made to pass through chambers of heated chequer work, into which a thin stream or spray of petroleum is injected, and the oil being gasified by the hot brickwork into oil gas mingles with the hot water gas, and the mixture being fixed,—that is any oil remaining as vapour being converted into permanent gas by passage through another heating chamber,—the now highly illuminating mixture is known as "carburetted water gas."

The composition of the mixture will, of course, vary with the proportion of oil gas mixed with the water gas, but the quality most used for enriching coal gas is from 20 to 22 candle gas and has the approximate composition :—

Hydrogen	37·20
Saturated hydrocarbons	18·88
Unsaturated hydrocarbons	12·82
Carbon monoxide	28·26
Carbon dioxide	0·14
Oxygen	0·06
Nitrogen	2·64
	100·00

So that the dilution of water gas by oil gas reduces the percentage of carbon monoxide to 28·2, but with the exception of a short period in one of the divisions of Liverpool, carburetted water gas alone has never been distributed in this country, although in America 296 of the largest companies send it out as a domestic supply.

In Great Britain it is almost entirely used to enrich and augment the supply of coal gas, and the amount added depends largely upon local circumstances, the following Table showing the maximum and average percentages put into the coal gas in some of the more important towns :—

Town.	Maximum.	Average.
Bath	40	10
Belfast	50	30
Birkenhead	64	36
Birmingham	24	
Blackburn	33	
Bridlington		25
Brighton	42·79	22·25
Colchester	20	
Coventry	44	28
Hastings	33	
Hornsey	36	
Liverpool	50	
London (north of the Thames)	20-25	
Middlesborough	33	
Norwich	36	
Preston	50	30
Southend	45	
Southport	26	
Swansea	25	
Taunton	40	
Tottenham	50	
Winchester	30	

So that under ordinary conditions of working it is safe to say that 20 to 50 per cent. of carburetted water gas is added to the coal gas supply. The whole question of what quantity shall be permitted hinges on the percentage of carbon monoxide present in the mixture, and this should be kept down to a point that should prevent such small leakages as are possible in a dwelling room from being actively injurious or endangering life.

It must be remembered that coal gas itself contains a certain proportion of carbon monoxide, the quantity being dependent upon the composition of the coal and upon the conditions of temperature and exhaust in the retorts. It has been found that the presence of combined oxygen in coal gives rise during carbonisation to the formation of oxides of carbon, and M. Ste Claire-Deville, from a long series of experiments on 59 different kinds of coal, established the following relations :—

In Coal.	In Gas.	
Percentage of Oxygen.	Carbon-dioxide.	Carbon-monoxide.
	Per cent.	Per cent.
5 to 6·5	1·47	6·68
6·5 ,, 7·5	1·58	7·19
7·5 ,, 9	1·72	8·21
9 ,, 11	2·79	9·86
11 ,, 12	3·13	11·93

The presence of the oxygen also in large percentage in the coal generally means a high yield of volatile hydrocarbons, hence a gas of high illuminating power, but such coals are rather avoided by the gas manager, as they are high in price and ruin his coke. High retort temperatures also seem to have an effect in increasing the percentage of carbon-monoxide. In the analysis of gas by Mr. Lewis T. Wright, already quoted, it will be seen that whereas a Derbyshire caking coal yielded 8·72 per cent. of carbon-monoxide when distilled at a dull red heat, the same coal yielded 13·96 per cent. of this gas at a bright orange heat.

A heavy exhaust would also tend in the same direction, as any trace of air leaking into the retort would form the monoxide. With the coals most used, however, from the Newcastle and Durham districts, the average percentage of carbon monoxide rarely exceeds 4 to 5; and it is now possible to gain an idea of the quantity that might with safety be allowed in the mixture sent out as illuminating gas.

There is no danger of poisoning by such mixtures during the day time, as the smell of the gas attracts attention to the danger long before the gas reaches a serious proportion; nor is it any good considering the cases of large leaks, as from broken mains or torn down fittings, for there would always be the risk of fatal results, whether the gas was coal-gas only or a mixture of coal and water gas.

The real risk is during sleep from such leakages as might be produced by leaky joints or partly re-turning a loose tap when putting out the gas. Such a leak would practically never be a serious one, as, if it were, it would be detected before the occupant of the room could get to sleep.

My own view is that practical safety is assured as long as the percentage of carbon monoxide in the gas supply does not exceed 16 to 17. In the departmental committee's report they recommend "that the proportion of carbon monoxide in the public gas supply at night should be regulated to 12 per cent., or such greater amount as the department may consider desirable;" and in the body of their report they say—"In some cases 12 per cent. of carbon monoxide in the gas supplied might be proper, in others 16 or perhaps 20. . . . With the present condition of gas supply, 20 per cent. is the highest proportion of carbon monoxide that should be allowed, and this percentage should be used only under special circumstances."

The views of the authorities in London are that the amount of carbon monoxide in the gas distributed should not exceed 16 per cent., and the Legislature is always so chary of doing anything to hamper unnecessarily a great industry, that the limit is not likely to be fixed below this point; indeed, as coal gas *per se* may contain up to 12 per cent., fixing anything lower than 16 would be practically prohibiting the use of a valable adjunct to gas manufacture. Taking, for the sake of calculation, the allowable limit as 16 per cent., this would mean that an ordinary coal gas containing 5 per cent. of carbon monoxide, might have its bulk increased by carburetted water gas until the mixture contained 52 of coal gas and 48 of carburetted water gas, whilst if blue water gas were used, the limit would be reached when the mixture contained 66 of coal gas to 34 of blue-water gas: in other words, to 100 volumes of coal gas you might add 92 of carburetted water gas, or 51·5 of blue-water gas, before reaching the limit of 16 per cent. of carbon monoxide in the mixture. The bearing of these figures will become apparent when we consider the factors that must govern the production of low-grade gas.

Correspondence.

SWEET POTATOES AND YAMS.

During the period of stress which our sugar-growing colonies in the West Indies are passing through, pending the abolition of the foreign sugar bounties, the attention of the planters has naturally been given to other produce. In Barbados great success has been achieved in the cultivation of sweet potatoes and yams of the very best quality, and an endeavour is now being made to introduce these into this country. The sweet potato is a cheap and palatable vegetable, but a good yam is a positive luxury.

During a long residence in London I imported several barrels every year for my own use, and out of the numerous guests who tasted them at our table there was not one who did not highly appreciate them. I may add that here the flavour is even more delicious than in the West Indies, as the butter, which is a vital ingredient in a well-cooked yam, is so much better.

I am returning to Barbados almost immediately, but any information on this subject will be given by Messrs. W. Pink and Sons, of Portsmouth, who are importing regular supplies. Receipts for various ways of cooking both sweet potatoes and yams re sent out with every parcel.

FORSTER M. ALLEYNE,
Legislative Council of Barbados.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Wednesday Afternoon, January 7, 5 p.m. (Juvenile Lecture.) Professor Edward B. Poulton, M.A., D.Sc., F.R.S., "Means of Defence in the Struggle for Life among Animals."

Lecture II.—"The Ways in which Animals warn their Enemies and signal to their Friends."

JUVENILE LECTURES.

On Wednesday afternoon, December 31st, 1902, Professor Edward B. Poulton, M.A., D.Sc., F.R.S., delivered the first lecture of his course addressed to a juvenile audience, on the "Means of Defence in the Struggle for Life among Animals."

The special subject of this lecture was the "Methods by which animals hide in order to escape their enemies and catch their prey."

The main object of the defenceless animals was to escape from their enemies by assimilating themselves with their surroundings, thus also enabling them to obtain food with safety. In a series of lantern slides the lecturer showed the different animals alone, and concealed by their surroundings. Fishes were shown with no evident means of protection, and again hidden in the midst of the grass which they mimicked. The fish held itself upright in the water, and imitated the motions of the grass which it resembled and by which it was surrounded. The next series of slides showed creatures which imitated different parts of a plant. Thus Professor Gregory gathered in British East Africa what he supposed to be a foxglove, but which really consisted of green and pink insects that flew away when the stalk was disturbed. Another similar case was recorded in that country, which differed in certain respects, but the lecturer thought that it would be possible to reconcile the conflicting evidence.

Professor Poulton said that it was not necessary to go to the Tropics for these examples of protection, because if they were sought for at home they would be found. Certain moths, daddy long legs, and caterpillars when in their proper positions, were often so wonderfully like their surroundings that it was by no means easy to distinguish them. In the slides, many of the animals were likely to have escaped notice if they had not been pointed out by the lecturer.

Many fish alter their colour in accordance with their surroundings, and Lord Lister discovered that this was due to the effect of light on the eye. The lecturer did not think that this held good in respect to insects, whose change of appearance, he believed, was effected through the nerves of the skin. He made special experiments on chrysalises, which changed in colour in adapting themselves to their surroundings. In one family of caterpillars fed on the same food each individual changed its appearance in accordance with the colour of the twig upon which it was placed.

It was said by some that the cases of mimicry were not so common as was supposed by the advocates of the theory, but the lecturer pointed out that in general we see only what we look for. He had himself found many cases of butterflies insufficiently protected which had been pecked at by the birds. The reason why attention had not been generally drawn to these cases was that the injured specimens were thrown away by the collectors. If, however, it was wished to collect these, plenty of specimens would be found to reward the search.

The lecturer referred to the different kinds of markings on the zebra and on the tiger which make these animals specially noticeable when they are seen in confinement, but which in their natural surroundings helped to hide them, the zebra from its enemies and the tiger from its prey. In conclusion, the Brazilian frog was shown alone, and also in the hole which it scoops out for itself when it lurks for prey. Professor Poulton said that he had shown many instances of the protection of animals from enemies, and few exhibiting the power of hiding from prey, but this was the proportion in which the two occurred in nature.

Proceedings of the Society.

CANTOR LECTURES.

"THE FUTURE OF COAL GAS AND ALLIED ILLUMINANTS."

By Professor Vivian B. Lewes,
Royal Naval College, Greenwich.

Lecture II.—Delivered Dec. 1st, 1902.

In the last lecture I traced the changes that had taken place in the conditions of gas supply, and showed why an illuminating gas of comparatively low light-giving power and good calorific value would be the need of the future. We can now proceed with the discussion of how this gas is to be best obtained; and, having gone into the question of what may be expected from high temperatures in carbonisation, can proceed to consider the effect of blue water gas as an economical diluent, taking as a dominating factor that we must not add more than 40 to 43 volumes of blue water gas to 100 of coal gas, for fear of raising the percentage of carbon monoxide in the mixed gases above the advisable limit, and also because directly that amount is exceeded it begins to interfere with the action of atmospheric burners as adjusted for coal gas, and tends to cause flashing back.

The only successful processes used in Europe and America for the production of water gas have depended on the system introduced by Gillard, in 1849, in which the temperature of a burning carbonaceous fuel, such as coke or anthracite, was raised to incandescence by means of an air blast, and then steam was passed through the incandescent fuel with formation of water gas until the temperature had been lowered to a point at which carbon dioxide began to appear in the gas to a serious extent, when the steam was cut off and the fuel again blown up to the required temperature by the air blast. the only differences in the systems adopted being in the form of plant and the arrangement of valves employed.

In all forms, however, up to 1895 but little attention was paid to the ratio existing between the air blast employed and the fuel in the generator. The result of urging the carbonaceous fuel to incandescence was to obtain a gaseous product generally known as producer gas, the composition of which is:—

Nitrogen	63·64
Carbon monoxide	29·33
Carbon dioxide	4·15
Hydrogen	2·88
	100·00

This, under certain circumstances, can be used as a fuel gas, as it contains some 32 per cent. of combustible matter.

In order to raise the temperature of the fuel, however, to a sufficiently high point for the formation of 1,000 cubic feet of water gas by the passage of steam through it, 44 lbs. of carbon had to be consumed during the blow, which yielded 4,000 cubic feet of producer gas. This in the processes for making blue water gas was blown to waste at the mouth of the generator, whilst another 15 lbs. of carbon was consumed by the action of the steam in making the 1,000 cubic feet of water gas itself; so that this amount of gas meant the consumption of about 60 lbs. of carbon. The average yield of water gas per ton of coke by this process was 34,000 cubic feet, which represents only some 34 per cent. of the thermal value of the carbon from which it was formed, and it is quite clear that such a loss as this would prevent the economic use of water gas made by such a process from being successful.

The plea put forward in favour of blue water gas as a fuel at this period was that you had the fuel in the form most easy of application, and that also, by utilising the producer gas as a fuel, the heat to be obtained from it brought the total calorific value of the two mixtures up to 80 per cent. of the thermal value of the carbon used.

This argument however, as regards thermal efficiency, was purely fallacious in practice, as the two gases, being produced intermittently, would have to be stored in order to utilise them separately, and the enormous bulk of the producer gas as compared with its thermal efficiency would have required such an amount of storage room as to render such use of it impossible, whilst if stored and therefore cold, it would have to be re-heated before it could be got to burn, owing to the 68 per cent. of nitrogen and carbon dioxide diluting the combustible gases.

The introduction of carburetted water gas however provided a really successful method of utilising the heat given off during combustion of the producer gas, as in the beautiful forms of apparatus devised for making the carburetted water gas, you really have a heat engine which does its work in a perfect way.

During the blow the producer gas, red hot from the generator, was consumed with the requisite quantity of air in the checker-brick cracking and fixing chambers, which decompose the oil and convert it into a permanent gas. By the time the right degree of incandescence has been arrived at in the generator, the chambers designed for the oil gas manufacture have also reached the required temperature, so that when the air blast is cut off and steam admitted to the incandescent coke in the generator, and a stream or spray of oil passed into the cracking chambers, you have at once a process for making carburetted water gas proceeding under the best conditions; as the hot water gas, sweeping forward through the cracking and fixing chambers, washes out from them the oil gas as it is produced, and saves it from over-decomposition by contact with the heated walls of the chambers, so that in reality, in all those forms of carburetted water gas apparatus which have arisen as improvements of Lowe's original ideas, you have the full thermal value of both the producer and water gas being utilised.

On the Continent, however, where the oil supply is not under such favourable conditions as in this country, an economical method of producing blue water gas still remained one of the greatest needs of the technical world, and in 1896 Carl Dellwik gave a method of making water gas to the manufacturers, which in simplicity and ease of working could not be surpassed, and which in one step did away with the production of the well-nigh useless producer gas, and doubled the production of water gas per ton of fuel.

In the spring of 1897 I had the privilege of investigating this process at the little Westphalian town of Warstein, where Dellwik had the process installed. In the June of that year I gave a lecture before the Incorporated Gas Institute, at their Bath meeting, in which I gave the results I had obtained whilst working with the apparatus; and at the present day I gather considerable amusement and pleasure from looking back to the criticisms and remarks which were aroused at that time. An American correspondent of mine took the trouble of writing to one of the leading gas experts in Germany, asking for his opinion on the figures I had given. The reply received was that the results were absolutely impossible; and the writer was evidently not clear in his own mind as to whether I had been sufficiently intoxicated to have seen the results double, or was so incapable as not to be able to perform the experiments. I was, however, pleased to see a year later that the same gentleman had investigated the process himself and given the same figures, and is now one of the most ardent supporters of the process.

In this process (which I have described already on more than one occasion, and which I need only now, therefore, touch upon), by careful regulation of the grate surface, the height of the fuel bed, and the air blast, instead of bringing about incomplete combustion in the generator whilst blowing up to incandescence, and getting producer gas as a by-product, the ratios are so arranged as to give complete combustion aud to yield practically ordinary flue gas during this process. This means that the carbon monoxide produced in the old process of blowing was now burnt in the generator itself instead of in a supplementary chamber, as in the case of the Lowe process, and the extra temperature due to its combustion is given to the fuel, thereby raising it to incandescence in much shorter time than had been the case heretofore, and so reducing the amount of fuel consumed.

Burnt up by the excess of air during the blow, the carbon is converted into carbon dioxide and not carbon monoxide, so that instead of developing 2,400 pound-centigrade heat units per pound of carbon, it develops 8,080 for the same consumption, or an amount 3·37 times as great.

Having reached incandescence in this, the only rational and economical way, the fuel is then subjected to the action of steam. But the steam supply is so regulated that it is never at any time in excess of the quantity required for the formation of water gas. By this means oxidation of the carbon monoxide to carbon dioxide by steam, which always takes place to a small extent in the old process, is here avoided, and the result is that with a decent coke it is possible to produce 70,000 cubic feet of water gas per ton of carbon, as against 34,000 cubic feet with the old processes, a result which now makes water gas the most important factor in obtaining high temperatures. It is by this process that the blue water gas will have to be made in the future if it is to be successfully employed as an adjunct in the manufacture of an economical low grade gas.

Many experiments have been made with a view of seeing if the generators utilised for making water gas for the formation of carburetted water gas could be used on the Dellwik lines. It was soon found that the alterations necessary cost far more than a new plant, and

that an increase in the amount of air blast is by no means the only thing necessary to give the improved results, as unless this is accompanied by a careful regulation of the ratio between the fuel, grate area, and air blast, little improvement can be obtained. In America many attempts have been made to get away from the Dellwik patents by experiments in this direction, aad I was pleased to hear the other day from one of the leading water gas makers in America, that although he had blown his generators until, as he put it, the country round was an inch deep in ashes, he had absolutely failed to get any result approaching that given by the Dellwik plant.

Taking now our water gas made in the most economical way, we can proceed to see how it can be best used for diluting coal gas down to such standards as may hereafter be fixed upon. Mr. T. C. Paterson, in his inaugural address to the Incorporated Gas Institute last year, gave some most valuable figures on the relation of illuminating power and calorific value in gases, and tabulated the effect of diluting coal gas with uncarburetted water gas as follows :—

Percentages.		Illuminating Power.	Calorific Power, B.T.U.		B.T.U.'s per Candle.	
Coal Gas.	Water Gas.	Candles.	Gross.	Net.	Gross.	Net.
100	...	19·29	674·5	606·2	35·0	31·4
90	10	18·45	646·0	581·0	35·0	31·5
80	20	16·67	615·8	555 6	36·9	33·3
70	30	14·26	585·1	528·9	41·0	37·1
60	40	11·89	544·1	495·1	45·8	41·6
50	50	9·88	515·8	468·4	52·2	47·4
40	60	5·08	469·0	427·1	91·8	83·5
30	70	under 1·0	436·8	399·4	...	...
20	80	...	404·5	370·7	...	...
10	90	...	372·2	342·0	...	...
...	100	...	333·0	306·8	...	...

It will be seen from this that the thermal value per candle of illumination becomes higher with considerable rapidity as the candle power of the gas is reduced. This manifestly must be so, as when the coal gas contains 70 per cent. of water gas, the effect of dilution is to render it non-luminous, whilst the net calorific value is still close on 400 B. T. U's.

The effect which the initial candle power of the gas has upon the effect produced by diluting it with blue water gas is of the greatest importance in considering the formation of our low grade gas, as it is manifest that in making a cheap gas one would never use coals of a quality which would give 19·29 candle coal gas.

My first series of experiments in the direction of trying how best to make a low grade gas of satisfactory heating power was to test the effect of diluting coal gas of different calorific values with blue water gas, the gases being mixed *pro rata* as they flowed into the holder, and being allowed to stand over night to complete the mixing.

In practice, if a 16 per cent. limit was fixed by Parliament for the carbon monoxide in the gas, it would be manifestly unwise to approach the limit too closely, as during a press of work owing to fog or other causes that threw a strain on the resources of the works, a slight want of uniformity in mixing might bring the percentage above the limit. In these experiments 40 volumes of blue water gas were added to 100 of coal gas, which would give 28·5 per cent. of water gas in the mixture and bring the carbon monoxide up to about 14 per cent. The gases were measured through a meter before mixing, and the resulting mixture was tested for calorific value in a Junker's calorimeter. The blue water gas used was purified from carbon dioxide, and had a calorific value of

	Gross.		Nett.
Calories per cubic feet ..	80·0	..	73·4
B.T.U. s ,, ..	320·0	..	293·6

The results obtained are shown in the following Table—

Illuminating Value of Coal Gas :					
Coal gas ..	..	17·6	16·0	15·3	15·1
Thermal Value :					
Coal gas.					
Calories gross	..	172·0	159·9	158·8	149·9
nett	..	155·3	143·8	142·0	134·6
B.T.U.'s gross	..	688·0	639 6	632·0	579·6
nett	..	621·2	575·2	568·0	538·4
Mixture.					
Calories gross	..	146·0	135·6	136·8	129·1
nett	..	131·7	122·8	123·2	116·7
B.T.U.'s gross	..	584·0	542·4	547·2	516·4
nett	..	526·8	491·2	492 8	466·8
Percentage Reduction in Thermal Value :					
gross	..	15·1	15·2	13·4	13·9
nett	..	15·1	14·6	13·4	13·3

This Table shows that given an ordinary gas coal, such as we should in practice use, yielding 10,000 cubic feet per ton of a 15 to 16 candle power gas, it may have added to the 10,000 cubic feet 4,000 cubic feet of blue water gas, with a reduction of only 13 to 15 per cent. in thermal value.

The experiments made by Mr. Paterson and others show that the reduction in candle power is practically proportional to the volume of water gas added, as one would expect, so that

the candle feet per ton of coal carbonised would be practically the same whether they were present in 10,000 cubic feet of coal gas or 14,000 cubic feet of the mixture.

Instead, however, of mixing the blue water gas with the cold coal gas, a distinct advantage is to be gained by passing the gas into the foul main. This is done at several places in Germany, notably at Erfurt, and it is found that a distinct gain in candle power is obtained owing to the water gas becoming to a slight extent carburetted with benzol vapour present in the hot gas, which if allowed to cool would be taken up by the tar.

I regret to say that I have no direct figures which show the result of percentage admixtures made in this way, of blue gas and coal gas, as in all the works where it is used, the mixed gases are benzolised, *i.e.*, enriched to a small extent by benzol before being sent out. The saving is found by less benzol being required to bring the gas up to a given candle power when the mixture is made in this way than when, as is done in some other places, the water gas is enriched with benzol, and is then afterwards mixed in with the coal gas.

In utilising water gas for the dilution of coal gas, it is possible, however, to make it perform a far more important function than that of merely increasing the volume. One of the weakest points in the manufacture of coal gas is to be found in the process of carbonisation, which has undergone little or no change since the earliest days of the gas industry. When the coal is placed in the hot retort, evolution of gas at once commences with great rapidity, and working with a five hours' charge, the largest proportion and the richest portion of the coal gas is evolved during the first three hours. The general course of the reactions are well shown in the following Table of results found by Mr. Lewis T. Wright in his studies on carbonisation :—

Time of observation (seconds).	Percentage of total gas evolved.	Average retort temperature.	Candle power per 5 cubic feet.
		deg. F.	
30	12·3	1108	21·8
60	26·1	1212	20·2
90	38·9	1200	17·7
120	52·6	1292	14·8
150	65·8	1315	13·5
180	78·6	1360	11·7
210	86·5	1435	10·7
240	92·6	1531	7·1
270	96·4	1613	5·1
300	100·0	1671	3·8

A moment's consideration of the actions taking place during carbonisation shows that whereas, in order to obtain the best results, the coal gas during retorting ought to remain under absolutely uniform and reliable conditions of temperature and time of exposure to the heat of the retort, yet these are the very factors which it is absolutely impossible to obtain under existing circumstances. The gas and vapours generated from the coal at the mouth end of the retort have only a very short exposure to radiant heat from the walls of the retort, as they are hurried out by the volume of gas behind them, and therefore they leave almost unacted upon by the heat, whilst the gas from the extreme end of the retort, having nothing to urge it forward, gets largely decomposed by overheating, with the result that not only are many of the heavy hydrocarbons, which would have been of the greatest value as illuminants to the gas, broken down into methane, hydrogen, and carbon, but also the over-baking yields a large percentage of the naphthalene found in the tar and mains.

It has always been a dream of the gas manager to devise some process which would enable him to decompose the tar formed during destructive distillation, and by getting from it hydrocarbons of high illuminating value, to do away with enrichment by other and more costly processes. Many attempts have been made in this direction, but, so far, the only way in which tar has shown itself of value as an enricher has been to separate the benzol from it, and then return that benzol to the gas in the carburettor.

I have many times pointed out that when once formed tar is one of the most difficult bodies to decompose. Its formation is really due to two distinct sets of actions, a primary action in which liquid hydrocarbons distil as vapours from the less heated portions of the coal in the retort, and escaping decomposition by the radiant heat from the crown of the retort, condense as liquids again on cooling, whilst a secondary reaction is of a synthetic character, and results in the formation of naphthalene, carbon and many of the heavier constituents of the tar, by the polymerisations and decompositions taking place in the heated crown of the retort at the expense of hydrocarbon gases which ought to find their way unaltered into the gas. I have also pointed out that the only rational method of getting the benefit of the hydrocarbons which are at present lost as

tar, is to prevent their conversion into that body.

In a lecture I gave before the Incorporated Institution of Gas Engineers in 1900, I suggested that instead of using water gas merely as a diluent, it should be made a factor in the distillation itself. I then proposed that a stream of water gas should be passed through the crown of the retort during the process of carbonisation, so as not only to hurry the newly born hydrocarbon gases out of contact with the hot walls of the retort, but also by diluting them to prevent the secondary reactions which were so important a factor in the production of tar from taking place, and by so doing to save many of the important lighting and heating constituents from destruction.

Through the kindness of Sir George Livesey and Mr. S. Y. Shoubridge experiments were shortly afterwards made at the Crystal Palace District Gas Works, giving results which pointed to this method of utilising water gas as of the greatest possible importance to the future of coal gas.

In these experiments a Derbyshire coal was employed, and the yield of gas and candle power given by the coal was tested on a large scale before, during, and after the water gas experiments. It was found that under ordinary conditions of carbonisation the coal yielded 10,468 cubic feet per ton of 15·88 candle power gas.

The plant used in the earlier experiment consisted of six beds of seven retorts each, and later of twelve beds of seven retorts. The section of all retorts was 22 inches by 16 inches and 20 feet long, they were heated by regenerative furnaces and charged by power-stoking machinery. The gas from them was passed through one complete section of the works separately, and was therefore condensed, scrubbed, purified and measured in the usual way—the ordinary gas manufacture being carried on at the time in other sections of the works.

The water gas was made in the ordinary "Economical" water gas plant, and conveyed from the relief holder to the retort house by a special pipe. This pipe was continued over the retort bench, just above the arch pipes on one side, and a connection was made from it to the top of each ascension pipe on that side of the bench. Each connection was fitted with a cock having a lever handle, with rod attached to it, so that the cock could be regulated from the charging floor. The dip pipes on this side were blocked and the hydraulic main valves closed. The water gas, therefore, descended the ascension pipes on this side, passed through the retort, and up the ascension pipes on the other side along with the coal gas.

The quantity of water gas which could be passed through each cock, when partly and when full open, was ascertained before the test by measurement through a meter. This enabled an approximate measurement of the quantity of water gas put into each retort to be made; but the actual quantity used in each experiment was checked by noting the quantity taken out of the holder. The heat of the retorts was maintained as nearly uniform as possible throughout the tests, and at as high a temperature as is used in ordinary working.

Many experiments were made in this way, all of which showed that important economies could be attained by the process. The following experiment will give an idea of the result obtained by using the 40 per cent. of blue water gas in this way as compared with the 40 per cent. simply mixed with the coal gas:—

Coal carbonised	82 tons.
Make of mixed gas per ton	13,730 cubic ft.
Water gas added per ton	4,005 ,,
Proportion water gas added	41·1 per cent.
Proportion water gas in mixture	29·1 ,,
Candle power..........	14·87 candles.
Candle ft. $\frac{13.730 \times 14{\cdot}87}{5}$ = 40,833	,,
Standard $\frac{10.468 \times 15{\cdot}88}{5}$ = 32,416	,,
Gain in candle feet on standard	25 per cent.

ANALYSIS OF GAS.

	I.	II.
Hydrogen	50·37	50·62
Saturated hydrocarbons ..	29·24	29·49
Unsaturated hydrocarbons	2·98	2·48
Carbon dioxide..........	0·49	0·49
Carbon monoxide........	14·92	14·92
Oxygen	Nil	Nil
Nitrogen	2·00	2·00
	100·00	100·00

CALORIFIC VALUE.

Calories......	149 8 gross.	132·9 nett.
B.T.U.	599·2 ,,	531·6 ,,

These experiments were renewed in 1901 with inclined retorts instead of horizontal, and a bench of 70 inclined retorts which had been newly erected, was utilised for the purpose.

The water gas was made, as in the previous experiments, in the generator of the "Economical" plant usually employed for the manufacture of carburetted water gas. The gas was passed into a holder of 469,800 cubic feet capacity, and thence was carried to the inclined retorts, into which it entered at atmospheric temperature. The gas was not purified before being admitted to the retorts, but was tested for carbon dioxide, of which it contained from 5 to 6 per cent. The carbon dioxide, after estimation, was deducted by calculation from the volume of water gas used, because the volume of mixed gas produced was measured in station meters after the whole of the carbon dioxide had been removed by purification in the usual manner.

To ascertain whether the carbon dioxide in the water gas was converted into carbon monoxide by passage through the retorts, the mixed gas was examined at the inlet to the washers, and found to contain 3 per cent. of carbon dioxide. It may therefore be assumed that the carbon dioxide, as it passed through the retorts, was not converted to any appreciable extent into carbon monoxide.

No station meter could be placed at my disposal for the measurement of the water gas. The holder of known capacity (469,800 cubic feet) was therefore filled before the commencement of each experiment, no gas being admitted to the holder during any trial. The volume of the gas was obtained by recording the height of the holder at the commencement and completion of the experiment, and making all the necessary corrections for temperature and pressure. The quantity of water gas used during 24 hours varied in the different experiments from 200,000 to 370,000 cubic feet. The gas leaving the retorts was purified in the usual manner, and then passed through station meters, from which readings were made every hour.

During every hour the gas was slowly bypassed into a small holder, from which gas was drawn at the completion of each hour, for the determination of the illuminating power by means of the Referees' Table Photometer, and from this once every day gas was drawn for analysis and for the determination of its calorific power by means of a Junker's calorimeter.

The coal used in the experiments was the same kind of Derbyshire coal as had been used in the previous tests, but of slightly inferior quality. Before commencing the experiments with water gas, a trial run was made for seven days with the coal alone, the tests being made every hour, day and night, so as to obtain a standard for comparison. The principal results obtained were—

Total coal carbonised	603 tons.
Total gas made (corrected).	5,973,682 c. ft.
Make per ton	9,907 ,,
Average illuminating power (table photometer)	16·55 candles.
Total tar (hydraulic)......	5,060 gallons.
Tar per ton	8·3 ,,
Calorific power gross......	152·6 calories per c. ft.
,, nett	138·8 ,, ,,

These figures give the value of 32.792 candle feet per ton for the coal, and this figure is taken as the standard in the following experiments.

In arranging the apparatus for the experiments, the upper mouthpiece of each retort was fitted with a pipe and stopcock for the admission of the water gas.

These experiments were continued from June 19th to August 23rd, 1901. Passage of water gas in varying proportions through the retorts was tried, and also the influence of the period of carbonisation at which the flow of diluting gas was started. It was found that although the results obtained were far better than in the experimeuts made with the horizontal retorts, they were of the same kind, and that the gain in candle feet per ton gradually rose with increase in the volume of water gas used, reaching a maximum with about 40 volumes of water gas per 100 of coal gas, and decreasing when this point was passed.

Water Gas added per cent. of Coal Gas.	Candle Feet per Ton of Coal.	Percentage Gain per Ton of Coal in Candle Feet.
21·9	37.582	14·6
25·5	38,235	16 6
27·8	41,343	26·0
37·6	40,936	24·8
40·1	43,703	33·2
42·0	42,984	31 0
45·6	40,467	23·4

The most important data with regard to these experiments were given in a Table at the end of a paper read before the International Engineering Congress at Glasgow, last year, but the results are so extraordinary, and so full of interest, that it is as well to give the full data for two experiments, in which 40 and 42 per cent. of water gas respectively were added, as it gives a better idea of the scale of the experiment.

Coal used	85·4 tons.	88
Total make (corrected)	1,274,656 c. ft.	1,294,946
Make per ton	14,925 ,,	14,715
Illuminating power (table photometer	14·4 candles	14·85
Total tar (hydraulic)	690 galls.	651
Tar per ton	8·07 ,,	7·4
Water gas added	42·0 per cent.	40·1
Water gas in mixture	29·5 ,,	28·6
Water gas per ton of coal carbonised	4,415 c. ft.	4,215
Candle feet per ton	$\frac{14{,}925 \times 14\cdot4}{5} = 42{,}984$	$\frac{14{,}715 \times 14\cdot85}{5} = 43{,}703$
Standard for coal carbonised alone	32,792	32,792
Increase in candle feet	31·07 per cent.	33·2

Calorific Value.

	Gross.	Nett.	Gross.	Nett.
Calories	127·2	116·8	125·8	118·7
B T U	506·8	467·2	503·2	474·6
Carbon monoxide present in purified gas	14·0 per cent.		15·2 per cent.	
Gain in calorific value	25·5 ,,		22·4 ,,	

So that a gain of 31 to 33 per cent. in candle feet and 22 to 25 per cent. in total calorific value is attained.

One point which should be clearly borne in mind when using water gas to clear the hydrocarbon compounds out of the retort, is that cold water gas will have a cooling effect upon the crown of the retort and upon the gases evolved by the coal.

Every gas manager knows to his cost that unless the temperature in the ascension pipes rises above 470° F., he runs great risk of choked ascension pipes, and although the admixture of water gas reduces, and, indeed, does away with stoppages, owing to alteration in the character of the tar and to dilution, yet the cooling of the gas if carried to extremes is quite capable of bringing about the very trouble that the process when properly applied would entirely prevent. This is one reason why hot water gas should be employed in preference to cold. If, however, the conditions are such that the use of hot water gas is an impossibility, then the passage of the diluting gas should not be carried on for too long. Mr. Foulis has shown that the temperature of the gases in the ascension pipe at a distance of 18 inches from the mouthpiece average 890° F. (476° C.) shortly after the charge is introduced, and fall to 518° F. (287° C.) towards the end of the charge. It is evident from this that in order to maintain a temperature of not less than, say, 500° F. (277° C.) 18 inches above the mouthpiece, a very large proportion of water gas may be used during the first two hours of distillation, and then should either be reduced or cut off, the latter being the course most likely to be adopted in practice. During carbonisation the large volume of gas which is evolved during the earlier periods of the charge is that which contains the highest proportion of rich hydrocarbons, and these are the compounds, not only of highest illuminating value, but those most liable to be broken down into less valuable illuminating bodies by undue heating, whilst the gases evolved in the later stages of carbonisation are of low illuminating power and will withstand a higher temperature.

This falling off in the quality of the gas during carbonisation is partly due to decrease in the quantity of gas evolved leaving the gas exposed too long to the action of the heated walls of the retort, and still more to the fact that as the heat in the retort acts upon the charge of coal it is the large outer surface which is first affected, the bottom of the charge by direct contact with the retort, and the upper portions by radiation from the walls. Messrs. Folkard and Heisch showed that with six hour charges only one-sixth of the coal remained uncarbonised at the end of the third hour. This remained as a core in the charge surrounded by a crust of three inches of coke, and as the coke would be at a temperature not very far below that of the retort the heavy hydrocarbons evolved during the last period of the carbonisation would have been so degraded by filtering through the heated crust that the water gas would have but little chance of showing any profitable influence.

That this is so is indicated by the fact that in experiments made with cold water gas introduced an hour after carbonisation had started, and carried on for three hours, *i.e.*, until four hours of carbonisation had elapsed, a gain of only 16 per cent. in candle feet was obtained, whilst when the water gas was admitted directly after the charge and was continued for three hours, a gain of 33 per cent. in candle feet showed itself.

In order to show the greatest gain from the process, the water gas would have to be brought in a pipe through the retort itself, so as to be heated to the same temperature as the retort, and should then be discharged in the body of the coal, so as not only to hurry the gas out of the retort, but also out of the coke. To do

this in a practical way so as not to interfere with the charging and drawing of the retort is, I admit, an engineering difficulty. But I think if the value of the process was realised, it would soon be found possible with horizontal retorts to have the water gas tube, perforated at intervals, fixed on the bottom of the retort, and to slide in the charge of coal in a sheet iron tray loosely fitting the retort, and with a perforated and recessed ridge in its lower portion, which would slide over the water gas supply pipe, whilst the coke would be withdrawn in the tray when carbonisation was completed, and a fresh tray slid in to take its place. In this way the water gas would be heated in the pipe, and would pass through the charge, washing out the escaping gas, and giving a further gain. I fear, however, that the water gas itself would, under these conditions, attack an iron tube, and that a porcelain or fire-clay tube will have to be used.

The process has been tried at Remscheid in Germany, and has given results of the same character as those recorded here, whilst stopped ascension pipes, which were a constant trouble with the class of coal used there, have been reduced to one-third the previous number.

There is one point which must be clearly borne in mind by the gas manager in considering the economic use of water gas in the dilution of coal gas and the distillation of coal, and that is that the output of the works must be large enough to keep the water gas generator continuously working, as it is only under these conditions that the expenses can be reduced to a minimum. While it is perfectly possible to make water gas by the Dellwik process at a little over 3d. a thousand when the plant is being worked to its full capacity, the price will naturally increase where the size of the works only demands its being used for a few hours a day.

In large works blue water gas will, in the future, be an absolute necessity, but in the hundreds of small works that supply our country towns the benefits to be derived from its use are minimised to an almost vanishing point by the extra cost of production of a comparatively small quantity of gas. I have, during the last ten years, given a large amount of time to the question of how best to supply small works with an ally which shall prove of as much value to them as the Dellwik plant will to their larger brethren.

Mr. Tully, of Sligo, some two or three years ago, had a long conversation with me on the subject, and acting upon the suggestions which I have made to him from time to time, has perfected an apparatus which should be of the greatest possible value where the gas supply is only of moderate dimensions.

At the present time the recovery of benzol from the coke ovens on the Continent has so increased the output of that material that tar, which used to be the only practical source from which it could be obtained, has fallen in price until many works would be glad to dispose of all they produce at 1d. per gallon. Indeed in many cases it is being used as a fuel in the works, and the only way in which the price of small quantities of tar can be kept up for special purposes is by reducing as far as possible the amount for sale.

The lines on which Mr. Tully has been working have been to take my idea of decomposing hydrocarbons, such as heavy oils, in the fierce heat of the fuel of the water gas generator itself instead of in cracking chambers, as is usually done in making carburetted water gas, a process which demands a not too heavy grade of oil, and adapt it to the decomposition of tar, so regulating the temperature and the volume of tar that the latter is completely decomposed to carbon, methane, and hydrogen, together with small traces of more valuable illuminating hydrocarbons, and then to filter off the finely divided carbon produced by passage through the coke which is afterwards to feed the generator.

The apparatus which he has designed for this purpose consists of an iron shell lined with fire brick, and provided at the bottom with clinkering doors. The fuel used in it is under ordinary circumstances coke, although of course anthracite or even a certain proportion of bituminous coal mixed with coke may occasionally be employed. The fuel after ignition is raised to incandescence by air blasts from jets arranged close to the bottom of the generator. These air injectors carry in their interior the steam pipes so that when the necessary degree of incandescence has been reached, steam can be directed on the hottest part of the fuel. In the generator lining about midway is a flue provided with openings into the generator: the flue passes entirely round the generator and has its exit into a stack pipe closed at the top by a snift valve. The top of the generator has another exit leading into the upper part of the stack pipe. In this way during the blow the products of combustion are led away through the openings into the flue, ensuring a bed of incandescent fuel of constant height, and at

the same time, when steam is turned on, the resulting gases can be drawn off through either of the exits. Between the flue and the floor of the generator is a constriction, in the space below which are arranged the injectors, by means of which the tar is driven in by steam pressure.

In actual working the fuel is first raised to incandescence by the air blasts in the lower part of the generator, and the products, consisting of little else but carbon dioxide and nitrogen, escape into the air through the flue, the snift valve being left open. When the desired temperature has been attained the snift valve is closed, and tar or other heavy hydrocarbons are injected by steam into the annular space below the constriction. Rising through the incandescent fuel both the hydrocarbon and the steam are decomposed, the former into soot and gaseous products, whilst the latter yields water gas. During this time some steam is injected through the pipes in the interior of the air jets, by which means the clinker is broken up and more water gas formed.

The mixed gases then pass upwards with the finely divided carbon from the decomposition, and this latter is removed by passing through the fuel in the upper part of the generator, and, being brought down as the red hot fuel sinks, it reaches the zone of action where it at once is utilised for decomposing the steam before the larger masses of fuel are acted on, on account of its finely divided condition.

The gases, consisting of a mixture of hydrogen, methane, and carbon monoxide, pass away through the stack pipe by a cross pipe, which is fitted with a valve, by which it is closed during the blow.

The results obtained are that for a consumption of 28 lbs. of tar and 20 lbs. of coke, 1,000 cubic feet of a 10 to 12 candle gas can be obtained, having the composition:—

Hydrogen	64·4
Methane	12·0
Unsaturated hydro-carbons	3·0
Carbon monoxide	15·0
Nitrogen and carbon dioxide	5·6
Calorific value	400 B.T.U.'s.

The small coke consumption due to the bulk of the water gas being made from the carbon of the tar, reduces the price of the gas, and Mr. Tully estimates that it costs 6d. per 1,000 cubic feet. It is quite clear that such an apparatus using up the surplus tar and coke in a small works would be a valuable adjunct.

From this rapid review of the processes which are available for increasing the volume of gas obtainable from coal, so as most economically to obtain a large volume of a good quality heating gas, and, at the same time, to utilise to the full the illuminating value of such hydrocarbons as can be obtained from coal, it is clear that considerable economies can be effected. In a large works where the blue water gas could be made at 4½d. or 5d. a thousand cubic feet, it would be possible to put a 14 candle gas with a calorific value of 500 B.T.U.'s, or a little over, into the holder, at a cost of not much more than 9d. per thousand, as against 1s. per thousand, which we may take it now costs in large works to make a 16 candle power gas in the holder, so that an economy of about 2½d. per thousand would be arrived at in this way. But whilst strongly urging the importance of reducing the sale price of the gas to the consumer to the lowest possible point, it cannot be too strongly insisted upon that the main cost of the gas is not to be found in the retort house, and that therefore the economy to be effected can only be limited. The chief items which swell the cost of the coal gas to the consumer are charges on the enormous amount of capital sunk in mains and plant and the distributing charges, which cannot be avoided.

In considering the question of the illuminating value of the gas and its calorific value it must be apparent to every one who has studied the question that no definite relation can exist between them. You may take a dozen samples of illuminating gas of the same candle power, each of which will differ from the others in its composition, and as the calorific value is entirely dependent on the composition, you will often find two 16 candle gases varying in calorific value to a greater extent than between a 16 and a 15 candle power gas more nearly equal in composition. (See Table, p. 125.)

One of the most important points that has to be definitely settled, is the method which shall be adopted in testing the illuminating value of low grade gas, *i.e.*, gas having an illuminating value of from 15 to 10 candles.

The Gas Referees have provided a well nigh perfect photometric method for testing gas of an illuminating value of 16 candles, and one which gives satisfaction alike to the gas companies and the authorities whose duty it is to see that the gas companies fulfil their Parlia-

mentary obligations. But with reduction in the standard of illumination the London argand, which is the standard burner for the consumption of 16 candle power gas, must, in order to develop the proper illumination from the lower value of gas, be used under the conditions for which it was constructed, as otherwise a grave injustice is done to the gas, and friction is sure to arise.

The following Table gives a good idea of the general run of values :—

RELATION OF ILLUMINATING VALUE AND CALORIFIC VALUE.

Illuminating Value obtained by burning to a 16 candle flame and correcting to 5 cubic feet consumption.	Calorific Value.			
	Calories per cubic foot.		B.T.U.'s	
	Gross.	Nett.	Gross.	Nett.
11·8	129·6	115·7	518·4	462·8
12·0	129·1	116·7	516·4	466·8
12·0	136·8	123·2	547·2	492·8
12·4	134·2	120·4	536·8	481·6
12·8	135·6	122·8	542·4	491·2
14·0	136·1	121·8	544·4	487·2
14·6	150·9	135·3	603·6	541·2
15·1	149·9	134·6	599·6	538·4
15·3	154·4	138·9	617·6	575·6
15·3	158·0	142·0	632·0	568·0
16·0	158·0	142·6	632·0	570·4
16·0	159·9	143·8	639·6	573·2
16·1	158·3	142·1	633·2	568·4
16·8	160·6	144·7	642·4	578·8
16·8	167·6	151·0	670·4	604·0
17·0	163·6	147·0	654·4	588·0
17·4	162·6	146·1	650·4	584·4
17·2	168·2	151·6	672·8	616·4
17·6	172·0	155·3	688·0	621·2

It is clearly recognised by every one who has had practical experience in the testing of burners, that the chief factor in developing the true illuminating power of the gas is that the air supply, whilst sufficient to prevent the escape of any unburnt gas, or products, should not be fed to the flame in too large a proportion, as otherwise combustion is completed before the separation and incandescence of some of the carbon particles has had time to add its iota of luminosity to the flame, and the illuminating power is in consequence reduced.

Now the London argand was devised by Mr. William Sugg to develop the maximum luminosity supposed to be possible from a gas of between 16 and 17 candle power, and the air supply to the flame, as regulated by the openings at the bottom of the burner, was so adjusted as to give just the necessary amount of air for this quality. As any fall in candle power means a reduction in the quantity of air necessary for the development of the maximum amount of light, a fall in candle power to 15·5 candles causes an over-aeration, and so accentuates the loss of illuminating value. This was recognised by the Gas Referees, who, in introducing the Table Photometer, altered the rate at which the gas was burnt at the standard burner from 5 cubic feet per hour to such a rate as will give a light of 16 candles. The recorded illuminating value is then calculated from the rate of combustion, so that if a gas of less than 16 candle value were burnt, the increased quantity of gas consumed should balance the excess of air supplied to the burner.

I have made many experiments to determine the influence of the various ways in which the standard London argand could be used in testing illuminating value. For all practical purposes these are four in number.

(1). To burn the gas as in the old methods of photometry at a fixed rate of 5 cubic feet per hour.

(2). To supply gas to the burner until the flame has a value of 16 candles, and then to take the rate of flow necessary to produce this light, and calculate back what the illuminating value of 5 cubic feet would be.

(3). To burn the flame at a fixed height of three inches, which was the size of flame given by a 16 candle coal gas burning at the rate of 5 cubic feet per hour, and arrive at the true illuminating value of the gas from the consumption, as in the second method.

(4). To burn the gas at a 16 candle rate, but to fix the burner in a position which would make the light on the photoped equal to 14 candles, or to any other number of candles that may be prescribed.

I used to be strongly of opinion that the right way to utilise the London argand was always to burn the gas at such a rate as would give a flame of three inches in height, as under those conditions you have the air supplied to the burner exactly fulfilling its normal functions, the height of the flame being an indication of the distance which the combustible gases have to travel before they can obtain the volume of air needed for combustion. Many experiments made during the last twenty years have all indicated that by using the burner in this way the candle power of gases, varying from 25 to 12 candles, can be satisfactorily determined.

There is one trouble, however, in using this method in practice, and that is that it is very difficult to get an exact determination of the height of the flame. But I have found by a long and very carefully carried out series of experiments that between 17 and 12 candles the results given by burning the gas to give a flame equal to 16 candles are in such close agreement with those given by burning it with a three-inch flame that for experimental purposes they are identical, and in as much as burning it at the 16 candle rate enables one to use the Table Photometer, as constructed for 16 candle gas testing, it is manifestly better to adopt a system which requires no alteration in methods prescribed by the Referees.

This being so, we can now discuss the relative merits or demerits of testing the gas by consuming it at a five cubic feet rate and at the 16 candle rate with correction back for differences in consumption. The fact that these two methods give very divergent results directly the illuminating power falls to 15½ is well known, and I think the following experiments show the reason of this divergence.

Taking analyses of a 16 and 14 candle gas made during these experiments the figures are :—

	16 candle gas.		14 candle gas.
Hydrogen	52·62	..	56·95
Methane	36·10	..	29·05
Ethylene	3·07	..	4·00
Benzene	1·00	..	0·50
Carbon monoxide	5·52	..	7·50
Nitrogen	1·69	..	2·00
Air needed for complete combustion of 5 c. ft.	29·49 c. ft.		26·5 c. ft.

and as the air ways of the London argand are constructed on the basis that 5 cubic feet of 16 candle gas require for their combustion 30 cubic feet of air, it is manifest that with a 14 candle gas of such composition burnt at the rate of 5 cubic feet per hour, 13 per cent. more air than is needed will be supplied to the flame. The result is at once apparent when the gas is tested for illuminating value at the 5 cubic feet rate

Gas tested at 16 candle rate	14·0
Gas tested at 5 cubic feet rate	11·5

a difference of about 18 per cent.

In this case the rate of flow had to be increased from 5 cubic feet to 5·7 cubic feet to obtain the 16 candle power flame, an increase in gas of 14 per cent., which, by utilising the excess of air to the best advantage, brings the illuminating value up to the standard which would have been given by a burner specially constructed for its combustion.

The wide divergence in the illuminating value ascribed to the flame of gaseous mixtures of varying quality is shown in the following Table—

Illuminating Power 5 c. ft. rate Corrected.	16-Candle Flame corrected to c. ft. rate.	Volume of Gas required to yield 16-Candle Flame.
Candles.	Candles.	Cubic Feet.
6·7	11·3	7·03
7·8	12·3	6·34
7·9	12·6	6·66
8·0	12·4	6·45
8·2	12·4	6·45
9·7	12·8	6·25
10·7	13·5	5·92
11·5	14·0	5·71
12·3	14·6	5·48
13·5	15·1	5·30
13·7	15·3	5·23
14·2	15·3	5·23
14·3	15·2	5·26
15·5	16 0	5·00
15·6	16·1	4·97
15·6	15·7	5·09
15·9	15·9	5·03
16·2	16·4	4·87
16·8	16·8	4·76
17·0	17·0	4·70
17·5	17·4	4·60
17·7	17·6	4·54

It is seen from this Table that for values between 17 and 15·9 candles it is immaterial as regards results whether the gas be tested at the 5 cubic feet rate, at a 16 candle flame, or a 3-inch flame, the value recorded being the same in each case, but directly the illuminating value falls below the lower limit, the 5 cubic feet rate of consumption at once begins to record an ever increasing falling off in value as compared with that shown by the 16 candle flame standard, this being due to improper regulation of the air supply to the burner, when the lower qualities of gas come to be burnt at a 5 cubic feet rate.

The only objection to burning the gas at a 16 candle rate and fixing the burner so much further from the photoped as to throw a light on it of 14 candles is that it seems unnecessary when the one correction will do all that is required.

The one point which is essential in using the London argand is that it should be used under the conditions for which it was made, and

that is with a 16 candle-power flame or a flame 3 inches in height.

The duty of prescribing what shall be the standard burner rests with the Gas Referees, and they being gentlemen of the highest scientific attainments and capability, the matter can be left entirely in their hands. But I should imagine that, in view of the divided opinion which exists as to the fitness of the London argand as a standard burner for qualities of gas below 16 candles, and the question that arises as to the way in which that gas should be burnt, they will in all probability prescribe another form of burner better adapted for the quality of the gas that is to be tested.

It is always of interest in a case of this kind to note the causes that led to the adoption of the existing standard, and the intentions of Parliament in forming the statutes which refer to it. The holding of the scales of justice betwixt the gas consumer and the gas companies had its origin, like many other good works, with the Corporation of the City of London, as it was their special Act (the City of London Gas Act of 1868), that created Gas Referees and a Chief Gas Examiner for the metropolis, and in procuring that Act their whole desire was to obtain absolute fairness both to the manufacturer and the public.

In the various discussions taking place in the committees of the Corporation on the subject of gas supply prior to the passing of this Act is to be found the history of the introduction of the London argand as the standard burner. It was in December, 1864, that my predecessor, Dr. Letheby, made a report on the gas supply in the City of London to the special committee appointed to consider the question, and from that report I take the following paragraph :—

"Since the month of February of this year, the gas of all the companies has been tested with a burner which raises the illuminating power about 12 per cent. over that of the old burner. The construction of the burner is strictly in accordance with the provisions of the Act of Parliament, and your officer has adopted it, after much consideration, because he has felt that, although the change from the old burner to the new is seemingly against the interest of the public, yet, if any question were to arise, in a court of law, concerning the defective power of the gas, it would, undoubtedly, be said by the companies that justice had not been done to them in the manner of testing; for, as no burner can *produce* light, but merely *educe* it, they are entitled to all the light that can be evoked from the gas by any burner which fulfils the requirements of the Act of Parliament."

It was in view of this that when the 1868 Act was passed, and the Gas Referees were created, and their powers defined, their clear duty with regard to the burner to be used for testing was laid down in Paragraph 43.

"The Gas Referees shall prescribe the burner for testing the illuminating power of the gas, and it shall be such as shall be the most suitable for obtaining from the gas the greatest amount of light, and be practicable for use by the consumer."

It is abundantly clear from this that the London argand was made the testing burner because it was the burner which did fullest justice to the gas at that period, and was at the same time one which the gas consumer could utilise if he thought fit.

The conditions under which gas is consumed in developing the illuminating power are now better understood, and the Gas Referees would manifestly be quite within their powers, in the case of new Acts lowering the candle power of the gas below 16 candles, in prescribing a different standard burner.

It is perfectly well known that the poorer the quality of the gas the lower must be the pressure at which it is supplied to the flame, and the thicker must be the layer of gas presented to the air, the air at the same time supplied to the flame being in the case of the argand burner reduced in quantity so as not to overburn the hydrocarbons. The form of argand burner made by Mr. Sugg, for 14 candle gas, is one which undoubtedly fulfils these requirements. It is a 15 hole argand, in which trapezoidal instead of circular holes are employed for the admission of the gas, and in which the pressure is reduced from about three-tenths, as used with the London argand, to a little over one-tenth, whilst the air supplied to the centre of the flame is reduced to the required amount by the introduction of a rod which contracts the area of the central passage.

I have made a long series of experiments with various qualities of gas with the 14 candle argand and the London argand, and find that when the London argand, supplied with gas at a rate to yield a 16 candle flame, shows on correction for flow of gas that the illuminating value is between 13·5 and 14·5, the 14 candle argand gives the same results with gas consumed at the 5 cubic feet rate: but directly the gas becomes poorer than 13·5, the 14 candle argand, at the 5 cubic feet rate, begins to show the same deterioration of illuminating value that the London argand used at the 5 cubic feet rate, does below 15·5.

If the supply of a low grade gas of the

character demanded by the needs of the future is to bear its proper economical value to the consumer, it is clear that in defining the quality of the gas, a new burner of this description must be adopted for each quality of gas if the 5 cubic feet rate is to be retained; and if it is desired to keep the London argand as a monument of the past, it must be used in such a way as to do the fullest justice that it can to the gas. But I also think that the time has now arrived when in devising the Parliamentary requirements, a standard of calorific value should also be introduced.

Miscellaneous.

LORD CURZON ON INDIAN ART.

The following report of the Viceroy's speech on opening the Exhibition of Art at Delhi on Tuesday last, December 30, is taken from *The Times* :—

The Viceroy this morning opened the Exhibition of Indian Art in the presence of a brilliant gathering of native Princes and a large assemblage of the general public. Lord Curzon, who was accompanied by the Duke and Duchess of Connaught and the Grand Duke of Hesse, delivered an address, in which he said :

"Since I have been in India I have made a careful study of the arts, industries, and handicrafts of the country, and have lamented their progressive deterioration and decline. When it was settled to hold the present gathering at Delhi, it struck me that here was the long-sought chance to do something to resuscitate the threatened handicrafts, to show the world what India was capable of, and possibly to arrest the process of decay. I appointed Dr. Watt, who is now on my right hand, and he, with Mr. Percy Brown, his assistant, travelled thousands of miles seeing artisans and selecting specimens. Three conditions were rigidly laid down—first, that the exhibition should be purely one of arts; second, that it should contain nothing European, but only work showing the ideas, the traditions, and the beliefs of the people of India; third, that it should contain only the best—namely, everything rare and beautiful in Indian art. My object has been to encourage and revive good work, not to satisfy the wants of a thinly-lined purse. This is not a bazaar, but an exhibition; but we have added something much more important. Being conscious that taste was declining and that many of the modern models were debased and bad, we have endeavoured to set up alongside the products of the present standards and samples of the past. This is the meaning of the loan collection, which has a special hall, where you will see many beautiful specimens of old Indian art-ware lent by the generosity of Indian chiefs and connoisseurs, some coming from our own Indian museums, some from the unrivalled collection of the South Kensington Museum. Many of these objects are beautiful in themselves, but we hope the Indian workmen here, and also the patrons who employ them, will study them, not merely as objects of antiquarian or artistic interest, but as supplying them with fresh, or rather resuscitated, ideas which may be useful as inspiring their own work in the future. This may be laid down as a truism, that Indian art can never be revived by borrowing foreign ideas, but only by fidelity to its own.

"I may be asked what is the object of this exhibition, what good I expect to result from it? I will answer in a very few words. So far as the decline of Indian arts represents the ascendency of commercialism, the superiority of steam power to hand power, the triumph of the test of utility over that of taste, then I have not much hope. We are witnessing in India only one aspect of a process which is going on throughout the world, that long ago extinguished the old manual industries of England, and is rapidly extinguishing those of China and Japan. Nothing can stop it. The power-loom will drive out the hand-loom, and the factory will get the better of the workshop, just as surely as the steam-car is superseding the horsed carriage, and the hand-pulled punka is being replaced by the electric fan. All that is inevitable, and in an age which wants things cheap and does not mind their being ugly, which cares a good deal for comfort and not much for beauty, which is never happy unless when asserting its own models and traditions, and running about in quest of something foreign or strange, we may be certain that a great many old arts and handicrafts are doomed. There is another symptom that, to my mind, is even more ominous. I am one of those, as I said, who believe that no natianal art is capable of continued existence unless it satisfies the ideals and expresses the wants of the nation that produced it. No art can be kept alive by globe trotters or curio hunters alone. If it has got to that point it becomes a mere mechanical reproduction of a certain fashionable pattern, and when the fashion changes and it ceases to be popular it dies.

"If Indian art, therefore, is to continue to flourish or is to be revived, that can only be if the Indian chiefs and aristocracy and people of culture and high degree undertake to patronise it. So long as they prefer to fill their palaces with flaming Brussels carpets, Tottenham-court-road furniture, cheap Italian mosaics, French oleographs, Austrian lustres, German tissues, and cheap brocades, I fear there is not much hope. I speak in no terms of reproach, because I think in England we are just as bad in the pursuit of anything that takes our fancy in foreign lands; but I do say that if Indian arts and handicrafts are to be kept alive, it can never be by outside patronage alone. It can only be because they find a market within the country and express the ideas and culture of the people. I should like to see a movement spring

up among the Indian chiefs and nobility for the expurgation, or, at any rate, the purification, of modern tastes, for a reversion to the old-fashioned but exquisite styles and patterns of their own country. Some day, I have no doubt, it will come, but it may then be too late. If these are the omens, what then is the aim of the exhibition and what purpose do I think it will serve? I can answer in a word. The exhibition is intended as an object lesson. It is meant to show what India can still imagine and create. It is meant to show that the artistic sense is not dead among its workmen, but that all they want is a little stimulus and encouragement. It is meant to show that for the beautification of an Indian house or the furniture of an Indian home there is no need to rush to European shops in Calcutta or Bombay, but that in almost every Indian State or province, in most Indian towns and many Indian villages, there still survives art, there still exist artificers who can satisfy the artistic as well as the utilitarian tastes of their countrymen, and who are competent to keep alive this precious inheritance which we have derived from the past. With this object Dr. Watt and I have laboured in creating this exhibition, and in now declaring it open it only remains for me to express the earnest hope that it may in some measure fulfil the strictly patriotic purpose for which it has been designed."

NEW COAL FIELDS IN BELGIUM.

The discovery of a new soft coal basin in the province of Luxemburg, north of the City of Liège, has recently been noted, and extensive soundings have been made over a considerable area. The deposit underlies many square miles of the northern part of Belgium and the southern part of Holland. One of the veins, at a depth of from 1,000 to 1,500 feet below the surface, is from 15 to 17 feet thick, and of a very fine quality of coal, according to Consul Winslow of Liège. It is estimated that this new field contains more than 500,000,000 tons of a good description of coal, and extensive preparations are being made to open up the mines. The Government proposes to enlarge the canals in that part of Belgium, dig new ones, and open new lines of railway. The working of these mines will be more difficult and expensive than in the case of other Belgian mines, because of their depth and the presence of more water, but it is thought that this will be more than counter-balanced by the thickness of the veins. The development of this field offers an opening for the introduction of up-to-date coal machinery.

Obituary.

ARCHBISHOP OF CANTERBURY.—Dr. Frederick Temple, Archbishop of Canterbury, whose death at Lambeth Palace occurred on Tuesday, 22nd December, had been a member of the Society of Arts since 1856, at which time he was an Inspector of Schools. Mr. Temple was one of the original examiners appointed by the Council of the Society in 1856, his subject being English History. He was joint examiner with Professor Brewer, of King's College, London. In 1859, Dr. Temple, then Head Master of Rugby, was examiner in Latin and Roman History, and he so continued until 1869, when he became Bishop of Exeter, and was succeeded by the Rev. Dr. Montagu Butler, Head Master of Harrow (now the Master of Trinity). The particulars of Archbishop Temple's distinguished career, and the expression of the wide-spread regret at his death have been so fully recorded in the daily press that it is not necessary to repeat here the incidents of his life.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock :—

JANUARY 14.—"Industrial Trusts." By PROF. W SMART, LL.D. SIR ROBERT GIFFEN, K.C.B., LL.D., F.R.S., will preside.

JANUARY 21.—"The Metric System." By A. SONNENSCHEIN.

JANUARY 28.—"The Cost of Municipal Trading." By DIXON H. DAVIES. The LORD CHIEF JUSTICE, G.C.M.G., will preside.

FEBRUARY 4.—"Methods of Mosaic Construction." By W. L. H. HAMILTON.

FEBRUARY 11.—"The Port of London." By Dr. B. W. GINSBURG.

FEBRUARY 18.—"Three-Colour Printing." By HARVEY DALZIEL.

Dates to be hereafter announced :—

"Existing Laws, By-laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions." By T. BRICE PHILLIPS. (Fothergill Prize Essay.)

"Oil Lighting by Incandescence." By ARTHUR KITSON.

"The Use of Electrical Energy in Workshops and Factories." By ALFRED C. EBORALL, M.I.E.E.

"Modern Bee-Keeping." By WALTER FRANCIS REID, F.C.S.

"Tonkin, Yunnan and Burma." By FRED. W. CAREY, late H.B.M.'s Acting-Consul at Szemao, China.

"Education in Holland." By J. C. MEDD.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

JANUARY 22.—"Indian Domestic Life." By JOHN DAVID REES, C.I.E.

FEBRUARY 26.—"Gleanings from the Indian Census." By JERVOISE ATHELSTANE BAINES, C.S.I.

MARCH 12.—"The Currency Policy of India." By J. BARR ROBERTSON. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

APRIL 23. — "The Province of Sind." By HERBERT MILLS BIRDWOOD, C.S.I., M.A., LL.D.

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 or 5 o'clock :—

TUESDAY, FEBRUARY 10, at 5 p.m.—"Women in Canada." By the COUNTESS OF ABERDEEN.

TUESDAY, MARCH 31, at 4.30 p.m.—"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo.

TUESDAY, MAY 5, at 4.30. p.m.—"Preservation of the Species of Big Game in Africa." By E. NORTH BUXTON.

Date to be hereafter announced :—

"Uganda." By HERBERT SAMUEL, M.P.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock.

JANUARY 20. 8 p.m.—"Principles which should guide all Applied Art." By G. F. BODLEY, R.A.

FEBRUARY 3. 8 p.m.—"The Teaching of Artistic Crafts connected with Books." By DOUGLAS COCKERELL.

FEBRUARY 17. 8 p m.—"Heraldry in Decoration." By GEORGE W. EVE, A.R.E. LEWIS FOREMAN DAY will preside.

MARCH 17. 4.30 p.m.—"Artistic Fans." By MISS HANNAH FALCKE.

APRIL 21.—

MAY 19. 4.30 p.m.—"The Mounting of a Play" (Stage Costumes and Accessories). By PERCY MACQUOID, R.I.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

JULIUS HÜBNER, "Paper Manufacture." Four Lectures.

LECTURE I.—FEBRUARY 2.—History—Cellulose—Raw materials—Boiling, washing, breaking, and bleaching of rags—Esparto—Straw.

LECTURE II.—FEBRUARY 9.—Soda recovery—Manila hemp—Jute and other raw materials—Mechanical wood—Wood cellulose—Beating—Sizing—Loading—Colouring.

LECTURE III.—FEBRUARY 16.—Stuff-chest—Regulator — Sand-tables — Strainer — Hand-made paper—Fourdrinier paper machine.

LECTURE IV.—FEBRUARY 23.—Single cylinder and other types of paper-making machines—Finishing — Cutting—Statistics—Paper-testing—Experimental paper making.

PROF. J. A. FLEMING, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." Four Lectures.

March 2, 9, 16, 23.

W. WORBY BEAUMONT, Mem.Inst.C.E., "Mechanical Road Carriages." Four Lectures.

April 27, May 4, 11, 18.

MEETING FOR THE ENSUING WEEK.

MONDAY, JAN. 5...Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Dr. J. T. Hewett, "Note on the Fluorescence of Naphthalic Anhydride." 2. Dr. J. Lewkowitsch, "The Saponification of Fats and Oils by Means of Dilute Acids."
Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. J. W. Woodall, "Nautical Astronomy, from a Yachtsman's Point of View."
Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. The Rev. Professor D. S. Margoliouth, "Forecast of the Future of Islam."
London Institution, Finsbury-circus, E.C., 4 p.m. (Juvenile Lecture.) Rev. Canon Benham, "Old London Houses." (Lecture I.)

TUESDAY, JAN. 6...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Prof. H. S. Hele Shaw, "Locomotion—on the Earth, through the Water, and in the Air." (Lecture V.)
Pathological, 20, Hanover-square, W., 8½ p.m.

WEDNESDAY, JAN. 7...SOCIETY OF ARTS, John-street, Adelphi, W.C., 5 p.m. (Juvenile Lecture.) Prof. E. B. Poulton, "Means of Defence in the Struggle for Life among Animals." (Lecture II.)
Geological, Burlington-house, W., 8 p.m.
United Service Institution, Whitehall, S.W., 3 p.m. (Juvenile Lecture.) Lieut. Henry Chamberlain, R.N., "The Siege of Delhi, 1857."
Obstetrical, 20, Hanover-square, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 4 p.m (Juvenile Lecture.) Rev. Canon Benham, "Old London Churches." (Lecture II.)

THURSDAY, JAN. 8...Antiquaries, Burlington-house, W., 8½ p.m.
Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. A. Marshall Arter, "Indicating High Speed Engines."
Royal Institution, Albemarle-street, W., 8 p.m. (Juvenile Lecture.) Prof. H. S. Hele Shaw, "Locomotion—on the Earth, through the Water, and in the Air." (Lecture VI.)
Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. W. B. Esson, "Notes of Recent Electrical Design." 2. Mr. E. K. Scott, "Notes on the Manufacture of large Dynamos and Alternators."
Mathematical, 22, Albemarle-street, W., 8 p.m.
Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. Horsley Hinton, "Some Practical Aspects of Pictorial Photography."

FRIDAY, JAN. 9...United Service Institution, Whitehall, S.W., 3 p.m. (Juvenile Lecture.) Dr. T. Miller Maguire, "The Recent Campaigns in Tirah, Burmah, and China."
Geographical Association, College of Preceptors, Bloomsbury-square, W.C., 3½ p.m. Annual Meeting. 1. Address by the Chairman, Mr. Douglas Freshfield. 2. Sir John Cockburn, "The Australian Commonwealth."
Astronomical, Burlington-house, 8 p.m.
Philological, University College, W.C., 8 p.m.
London Institution, Finsbury-circus, E.C., 4 p.m. (Juvenile Lecture.) Rev. Canon Benham, "Old London and the People." (Lecture III.).
Clinical, 20, Hanover-square, W., 8½ p.m.

SATURDAY, JAN. 10...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Wednesday, January 14, 8 p.m. (Ordinary Meeting.) Professor W. Smart, LL.D., "Industrial Trusts." Sir Robert Giffen, K.C.B., LL.D., F.R.S., in the chair.

Further details of the Society's Meetings will be found at the end of this number.

CANTOR LECTURES ON "PHOTOGRAPHY AS APPLIED TO ILLUSTRATION AND PRINTING."

Mr. J. D. Geddes's Cantor Lectures on "Photography as Applied to Illustration and Printing" have been reprinted from the *Journal*. The pamphlet (price One Shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

A full list of the Cantor Lectures which have been published separately and are still on sale can be obtained on application to the Secretary.

JUVENILE LECTURES.

The second and last lecture of the course of Juvenile Lectures on the "Means of Defence in the Struggle for Life among Animals," was delivered on Wednesday, the 7th inst., by Professor Edward B. Poulton, M.A., D.Sc., F.R.S.

The special subject of this lecture was "On the ways in which animals warn their enemies and signal their friends."

The object of warning colours and attitudes is the exact opposite of the concealing colours illustrated in the first lecture; for they seem to render an animal conspicuous to its enemy, easily recognised, and easily remembered. They are invariably associated with some exceptional mode of defence, such as an unpleasant taste or smell, irritating hairs, stings, the poison fang, &c. When an enemy has once experienced any of the unpleasant methods of protection it signally desires to avoid such prey in the future, and then the conspicuous warning appearance has the advantage that it is readily learnt and remembered. And it is a great advantage to animals with a warning appearance, that their enemies should learn their lesson easily, for this means a small waste of life instead of a large waste. It must not be supposed, however, that warning colours appeal to all enemies in the same way, for even the most distasteful animal will have certain foes which destroy it, in spite of the distastefulness.

Good examples of warning colours are seen in the conspicuous black-and-white American skunk (*Mephitis*) defended by the power of omitting an intolerable odour, in the yellow and black salamander, and in many conspicuous caterpillars, moths, and butterflies. In poisonous snakes it is common for the approaching enemy to be warned off by an intimidating attitude, as in the cobras, or by sound as in the rattle-snake or in the Indian *Echis*. Animals which can bite, such as lizards, or strike hard, such as large birds, are also apt to resort to intimidating attitudes. Even large caterpillars may assume a cobra-like appearance, but this is, as a rule, pure imposture (protective mimicry).

Another interesting point about warning colours is the tendency for the same colours and patterns to be used over and over again in the same country, so that enemies have not to learn as many appearances as there are specially defended animals. This results in the further saving of life during education, as was first pointed out by the great German naturalist Fritz Müller. Thus, distasteful butterflies often gain the same colours and patterns, and so do the stinging insects, strongly-smelling bugs, and the most highly protected beetles.

A very remarkable side of the subject has only recently been investigated. Certain African butterflies which are beautifully concealed from their enemies, and live in the winter season (*e.g.*, *Precis sesamus*), are proved to be the same species as certain others which are extremely conspicuous, and fly during the moist summer (*Precis octavius*).

In fact, one species of butterfly, having many generations in the year, produces conspicuous generations in the summer, and concealed generations in the winter. The one has been bred from the other in Rhodesia by Mr. Guy Marshall. This extraordinary alternation can be explained by supposing that the butterfly is moderately unpalatable to insect-eating animals, so that it is to the advantage of the generations which exist in a time of plenty to warn their enemies, but to those flying in a time of comparative scarcity to hide from their enemies.

Another kind of marking is beneficial in directing the attention of an enemy away from a vital part, such as the head or body. Thus the tails of lizards easily come off, and then become themselves most active, jumping about with the greatest vigour. They probably distract the attention of an enemy from an escaping lizard. Similarly, light patches of colour, eye-spots, and tail-like projections on the wings of butterflies divert the attention of enemies from the vital structures. Certain species of hermit crabs attach to their shells in which they live, other animals with special defences and bright warning colours, such as stinging sea-anemones, or unpalatable sponges. This corresponds to the use of foreign bodies for the purpose of concealment, as illustrated in the first lecture.

Recognition markings for, as it were, signalling to friends or other individuals of the same species are probably much less common than warning colours. They are most fully developed in animals which go about in numbers and whose safety depends upon keeping together or on the younger and less experienced following the older to a place of safety.

The CHAIRMAN (Mr. R. Brudenell Carter, F.R.C.S.) proposed a vote of thanks to Prof. Poulton, for his interesting course of lectures, which was carried unanimously.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

"THE FUTURE OF COAL GAS AND ALLIED ILLUMINANTS."

By PROFESSOR VIVIAN B. LEWES,
Royal Naval College, Greenwich.

Lecture III.—Delivered December 8th, 1892.

The alterations which are taking place in the conditions under which coal gas may be used for illuminating purposes are so entirely dependent upon the adoption of the incandescent mantle as a means of developing light, that one of the most important questions to be discussed must of necessity be the relation existing between illuminating power, calorific value, and the light that can be evoked from the gas when burnt in an atmospheric burner by means of the incandescent mantle.

At first sight there seems to be a wide discrepancy between observers on this point, and the literature of the past two or three years leaves one with a feeling of hazy uncertainty as to what relations really exist between the character of the coal gas and the light which the mantle will emit from it.

Herr W. von Oechelhaeuser came to the conclusion from experiments made upon the Dessau gas that a reduction in the illuminating power of the gas causes an increase and not a decrease in the candle power of the Welsbach light. These experiments we will discuss later on. Some time later Dr. Bunte read a paper before the International Gas Congress in Paris, in which he pointed out that the changes in composition of gas, which reduce the illuminating power in flat flame and argand burners to a very great extent, have but little effect in producing differences in the illuminating duty of the Welsbach burner, and he showed by photometric measurements that the gas supplied in Berlin, Charlottenburg, Dessau, and Karlsruhe, although varying in illuminating value from 7·7 candles up to 10·9, gave, in spite of this relatively wide divergence in illuminating value, no difference in the light obtained from the mantles. He also showed that the calorific values of these gases was very nearly equal. A series of papers by Messrs. White, Russell and Travers, in America, gives the results of a research on the incandescent mantle and its behaviour, and they came to

the conclusion that the light emitted by the mantle has little or no relation to the illuminating power of the gas when burnt *per se* as a luminous flame, and will increase almost directly with the nett calorific value, the increase being at the rate of 1 candle per cubic foot for every 4 calories increase in the nett heating value.

I especially notice these three sets of observations, as in each case the work was carried out apparently with the necessary precautions that should be taken in securing accurate results. But there have also been a large number of experimental determinations made, in which neglect of such important factors as the regulation of the air supply in the burner and the initial gas pressure have led to still more chaotic results.

In order fully to grasp this most important side of the question, and satisfactorily to determine the real effect produced, it is necessary to consider the factors which govern the atmospheric burner, and produce from coal gas the non-luminous flame which heats our mantle.

In a lecture on the theory of the atmospheric burner which I gave before the Incorporated Gas Institute in 1897, I pointed out that the portion of the bunsen flame which heated the mantle, no matter what the composition of the original coal gas and the amount of hydrocarbons which it contained, if the burner were properly regulated as regards the air supply, consisted, as far as the combustible constituents went, of carbon monoxide and hydrogen, so that leaving out of the question the initial heat given by the incomplete combustion in the inner zone, water gas burnt without any admixture of air, would prove a highly successful method of developing light from the mantle.

The chemical changes taking place in the flame of the atmospheric burner were first studied by Blochmann, whilst Prof. Smithells and I have of late years done considerable work on the subject. The actions taking place are perfectly clear. An ordinary 16 candle coal gas requires from 5·5 to 6 times its own volume of air for its complete combustion. If about half this volume of air is caused to mix with the gas before ignition at the burner head the gas is consumed in two stages which give the dual character to the flame, the inner cone being produced by incomplete combustion at the expense of the previously admixed air, whilst the outer cone is due to the combustion of the products of incomplete combustion from the inner zone, which takes place at the expense of the oxygen from the outer air.

Such a flame, however, is not the best that can be employed for heating the incandescent mantle. If the air supply be further increased, the inner zone, in which the primary combustion is going on, shrinks in size and becomes green in colour, and in an ordinary atmospheric burner, such as is used in laboratories, any further increase in the air supply before combustion causes the flame to flash back to the bottom of the burner. But with various forms of burners for incandescent mantle heating, arrangements are made which prevent this, and the quantity of air can be still further increased. The popular idea of such burners as the Kern is, that practically the whole of the air needed for the combustion is mixed with the gas before it burns at the burner top. This, however, is an entire mistake, and if such a result could be obtained, it would defeat its own purpose.

The best result is obtained from the incandescent mantle when a little over three-quarters of the requisite quantity of air is mixed with the gas. This gives an inner zone of a bright green, which appears to seethe and boil on the gauze top of the mantle burner, whilst the products of incomplete combustion escaping upwards from this zone consist of—

Water vapour	16
Nitrogen	60
Carbon monoxide	9
Hydrogen	10
Carbon dioxide	5

It is this mixture escaping red hot from the inner zone which, in its combination with the oxygen of the outer air, excites the mantle to incandescence. If the aeration of the gas before burning is pushed beyond this point, the candle power yielded by the mantle falls instead of rising.

Various theories have been put forward to explain the wonderful light emissivity of the incandescent mantle, the latest one being that of Messrs. White, Russell, and Travers, who conclude that the oxide of cerium is held in a state of solid solution by the oxide of thorium, and that this exerts a specific influence in altering wave lengths, so that the mantle emits more blue and green rays and fewer red rays, *i.e.*, converts more of the energy of the flame into light and less into heat than does the ordinary flame that owes its incandescence to carbon particles.

For my own part I do not agree with this,

and am in entire accord with the theory of Professor Bunte that the process of combustion and the heat given thereby are stimulated by the catalytic action of the material of the mantle; and I consider that Luggin's experiment, which showed that the Welsbach material can be brought by catalytic action in a cold mixture of gas and air to a state of full luminescence, to be conclusive evidence on this point.

Taking these factors with regard to the condition of combustion as existing in the atmospheric burner flame, it is evident that the calorific value of the original gas will exert a certain influence on the temperature of the inner zone of the flame, and that the superheating action of this upon the combustible constituents of the escaping gas and the escaping products of combustion, will influence the temperature existing on and close to the surface of the mantle, so that, supposing the burner to be working under the best conditions of air supply, the light emitted will follow the calorific value of the gas. But the difference between the illuminating value given will only be a very small proportion of the difference between the calorific value of the two samples of gas.

I showed in 1900 that the effect of the superheating influence of the inner zone upon the outer portion of the flame, is clearly demonstrated by using a Smithell's tube, by which the outer and inner zones of an atmospheric flame can be widely separated. Under these conditions, the superheating effect of the inner zone is reduced to a minimum, and a mantle heated in the outer zone gives but a poor light, whilst on allowing the inner zone to rise in the tube, the luminosity of the mantle increases, until, when it has resumed its normal position in the centre of the flame, the mantle emits its full light.

It is clear from this that the superheating by the inner zone plays a part in the light emitted by the mantle. But in all the experiments I have made with gases of varying illuminating and calorific values, I have failed to find any alteration in the light yielded by the mantle that would justify the adoption of such a ratio of decrease as that given by Messrs. White, Russell, and Travers, *i.e.*, one candle per cubic foot for a diminution of 4 calories, and I am forced to the conclusion from my own experiments that for calorific values such as mixed gases between 12 and 18 candle power possess, with proper air adjustment to the burner, the loss of light given by the mantle is so small as to be far overshadowed by the alterations in light due to inequality of shape in the mantle and other factors apart from the calorific value of the gas.

The record of one experiment will show what I mean. A good mantle on a "C" burner was tested with a 17·7 candle power gas and gave 20·6 candle per foot of gas. 40 volumes of blue water gas were then added to 100 of the coal gas, and time given to complete the mixing of the two gases; on again testing under precisely the same conditions as before the mantle gave 17·7 candles per cubic foot of gas, and the light became a little unsteady. A collar was fitted to the air holes of the burner, and on regulating the air supply until the mantle gave the best results, a light of 20·1 candles per cubic foot was obtained. The details of the experiment are:—

Gas.	Illuminating Power.		Calorific Value Calories.		Candle Power in mantle per cubic foot air.	
	Candles at 5 c. ft. rate.	Candles by 16 candle rate.	Gross.	Nett.	Ordinary.	Adjusted
Coal gas	17·7	17·6	172	155·3	20·6	20·6
Coal+water gas (100 + 40)	11·5	14·0	136	121·8	17·7	20·1

The pressure was $1\frac{1}{2}$ inches in each case, and the gas was burnt at the same rate of flow, *i.e.*, 4 cubic foot per hour in both experiments.

It is seen in this case that the loss of light given by the mantle was half a candle for a loss of flame illuminating value of 6·2 candles if tested by the 5 cubic feet rate, or 3·6 candles if tested in a rational manner. There was, moreover, a loss of calorific value in the gas equal to 33.5 calories. Therefore, according to the ratio given by Messrs. White, Russell, and Travers, the 20·6 candles per cubic foot ought to have been reduced by $\frac{33·5}{4}$ or 8·3 candles, so that 11·8 and not 20·1 candles should have been found.

It is clear, therefore, that if care be only taken to properly adjust the burners, air supply, and mantles to the gas supply of a district, which could easily be done, the differences due to the lowering of the candle and calorific value of the gas become so small as to be negligible.

To my mind this is a convincing proof of the truth of Dr. Bunte's catalytic theory of incandescence. If the light emitted by the mantle be due not so much to the temperature

of the flame as to innumerable points of high temperature created on the surface of the mantle by the catalytic action of the ceria upon the hydrogen and carbon monoxide, when once the temperature necessary to carry this on in the best way is reached, then the rise in temperature due to the combustion of a gas of high calorific value in the inner zone of the flame would merely increase the glow due to the effect of the slight extra heat on the mantle fabric. How small this is can be judged from the light emitted by a pure thoria mantle heated by the combustion of different grades of gas, and experiment shows that this is about the difference found in the experiment recorded with the 17·7 and 14 candle gas.

The results upon which Messrs. White, Russell, and Travers based their views on the effect of the calorific value of the gas on the mantle may be arranged in order in the following Table, interpolating the value in B.T.U.'s as well as calories :—

Comparison of the Heating Power of Gases with the Light given by the Incandescent Mantle.

Calories (nett) per c. ft.	B.T.U.'s per c. ft.	Pressure in 10ths.	Gas burnt per hour c. ft.	Total candle power.	Candles per c. ft.
60·24	240·96	22	7·58	41·92	5·53
62·39	249·56	20	7·20	69·63	9·67
67 03	268·12	20	4·93	27·13	5·54
108 90	435·60	20	5·20	91·00	17·50
112 11	448·44	20	4·95	102·95	20·69
130·90	523·60	20	3·56	77·83	21·86
140·55	562·20	20	3·45	87·04	25·60
144·30	577·20	20	3·25	82·65	25·40
147·86	591·44	21	3·40	96·67	28·48
153·83	615·32	20	3·50	95·91	27·40
156·10	624·40	21	3·10	92·24	29·75
162·96	651·84	20	3·00	96·30	25·43
169·60	678·40	20	3·15	103·73	32·90
219·28	877·12	20	2·05	45·90	22·94
239·38	957·52	20	1·80	74·96	41·63

The gas that heads the list with 60·24 calories nett is blue water gas, and they find that under the conditions of testing they employed, it gave with the mantles 5·53 candles per cubic foot. But with a burner of the shape adapted for the consumption of water gas I have obtained the following results :—

Blue Water Gas burnt in Argand Burner with Welsbach Mantle.

Pressure.	Gas consumed, cubic feet.	Illuminating power candles.	Candles per cubic foot.
5/10	6·2	120	19·3
8/10	7·0	137	19·8
11/10	8·0	145	18·1
12/10	8·5	145	17·0

The fact of 5·53 being put forward as what may be expected from blue water gas under the best conditions of burning, makes one feel disinclined to put any great degree of confidence in Messrs. White, Russell and Travers' results, which are manifestly wrong.

A point which cannot be too strongly insisted upon is that the mesh of the mantle and the size of the opening at the top are important factors in the light emitted by different grades of gas, and should be attended to with the same care as the degree of aeration. Experiments soon show that the mantle best fitted for use with a rich carburetted water gas, such as is used in America, would give very poor results with a 10 or 12 candle gas, whilst the gas ejector nipple suited to a rich gas is useless with a low grade gas. It may be neglect of such conditions as these that has led to such manifestly erroneous deductions.

The result of Herr Oechelhaeuser's experiment with Dessau gas, which showed that a reduction in candle power, as tested with a batswing burner, of from 13 to less than 2 candles, caused an increase of from 66·5 to 73·5 candles with the Welsbach mantle, may have been partly due to the conditions of air supply to the burner being better fitted for the combustion of the lower grade of gas ; but there is another factor that must not be lost sight of, as it has an important bearing on the use of blue water gas as a diluent for coal gas.

It is well known that the increase in volume of hydrogen and carbon monoxide, caused by diluting coal gas with blue water gas, shortens the flame and increases the intensity, and in this way makes the light of the flame whiter, due to the higher incandescence of the carbon particles. With the incandescent mantle the same thing is noticeable, and I have many times obtained the same result as Herr Oechelhaeuser.

In the case of the Dessau gas, the lowering in candle power was brought about by "stripping," *i.e.*, removing absorbable hydrocarbons, and this would have the same effect, as it increased the percentage of hydrogen present, and either this gas or carbon monoxide have the same shortening effect on the flame as the mixture of the two (water gas).

An even more accentuated case of the same character came under my notice last year. I was testing the gas in a northern town, and found that in the standard flat flame burner it gave an illuminating value of 20 candles. The gas was made from coal, and had an illuminating value of 15 to 14 candles before enrich-

ment, and it was brought up to 20 candle gas by benzol vapour. I was struck by the poor light given by the mixture in the incandescent lamps of the town, and on testing it with mantles burnt both on the ordinary "C" and Kern burners (No. 4), could only get a total illuminating value of 46 to 50 candles. I then tested the unenriched gas, which at that time had an illuminating value in the London argand of 14·11 candles, with the same mantles and burners as before, and got 80 to 90 candles without any trouble. The 20 candle benzolised gas had a calorific value of 608·8 nett B.T.U.'s, the 14·1 candle coal gas 510 B.T.U.'s.

I could only assume that benzolised coal gas was unfitted for use with incandescent burners with ordinary adjustments I repeated the experiment with the Kern burner, carefully measuring the rate of flow, and also trying the same coal gas enriched with petroleum spirit to 21·5 candle power.

KERN BURNER NO. 4 WITH MANTLE.

Enricher.	Illuminating value of gas.	Pressure.	Rate of flow.	Illuminating value.	Candles per cubic foot of gas.
Petroleum spirit ..	21·5	1·5	3·20	34	10·6
Benzol....	20.0	1·5	3·45	46	13·3
None	14·1	1·5	4·45	90	20·2

In all probability the explanation of these results is to be found in the fact that although the air holes of the burners were full open, they had been made for a 16 candle coal gas, and gave too small an aeration for the enriched mixtures, and that if the nipples of the gas injectors had been changed more normal results would have been obtained with the rich gas. I give these results, not as showing that enrichment reduces the lighting value that can be obtained from a mantle, but rather that the consumer is more likely to get his money's worth with a poor gas than with a doctored up high candle value gas, as in nine cases out of ten the burner vendors never take the trouble to adjust the burners to the quality of gas with which they are to be used.

Another question, which is an important one, is the effect of the pressure under which the gas is supplied to the burner upon the light emitted by the mantle. When the pressure of the gas rises the visible effect is an increase of light from the mantle, but within the ordinary limits of gas supply, *i.e.*, between 1 and 4 inches pressure, this increase is more apparent than real. Mr. Walter Grafton last year read a most interesting paper before the Gas Institute on the effect of quality and pressure on the efficiency of incandescent gas lighting, aud gave a table of the results obtained with various grades of coal gas and coal gas enriched by carburetted water gas, as well as a number of results obtained from mixtures of these gases with air.

Taking his results for the coal gas and enriched gas only, and calculating the results at 1, 2, and 3 inches pressure to candles per cubic foot, the following Table is obtained :—

Candle power of gas at 16 candle rate, corrected to 5 c. ft.	Pressure of Gas.					
	1 inch.		2 inch.		3 inch.	
	Total light.	Candles per c. ft.	Total light.	Candles per c. ft.	Total light.	Candles per c. ft.
13·32	56·0	14·8	60·0	11·0	56·0	8·3
14·18	57·0	16·2	55·5	11·7	55·5	9·6
14·80	57·5	16·6	53·0	10·9	49·0	8·2
15·65	63·0	17·8	77·0	15·9	72·5	12·0
16·19	51·0	15·0	57·5	11·9	61·0	10·8
16·48	55·0	17·5	61·5	13·2	61·5	10·7
17·35	63·0	18·9	70·5	15 0	67·0	11·5
18·30	53·5	16·2	47·5	10·0	44·5	7·8
19·90	53·0	19·1	86·0	21·8	92·5	19·0
23·70	62·0	21·7	87·0	21·7	89·0	18·5

This shows that the general tendency of such variations of pressure is to decrease the candles per cubic foot of gas consumed and that any increase of the total candle power is due to a very largely increased consumption.

When, however, high pressures are used, *i.e.*, pressures of 8 to 10 inches, such as are employed in high intensity lighting on the Sugg, Keith, or other systems, the high pressure of the gas enables some 10 cubic feet of gas to be consumed per hour in place of the 3½ cubic feet supposed to be used by the "C" burner, so that nearly three times the amount of gas is burnt in the same time and area, and results in a great increase in calorific intensity, with the result that over 30 candles per cubic foot can be obtained with London gas, and, of course, higher powers with a richer gas.

I have long since pointed out the importance of a thorough mixing of the gas and the air drawn in by the atmospheric burner in increasing the light given by the mantle, and it was to do this that Chemin, Denayrouse, Bandsept, and Kern devised the special forms of burners associated with their names.

The late Mr. Frank Livesey also showed that by allowing the gas to take in the needed air

some distance away from the burner head, so that a length of travel should bring about a more thorough mixing, an enhanced effect could be produced. In the paper by Mr. Grafton, already alluded to, he shows by carefully made photometric experiments that by making a mixture containing 15 to 30 per cent. of air with the coal gas after leaving the gas meter, the light emitted by the mantle is increased to such an extent that it far exceeds the ordinary results obtained for the same consumption of gas by other methods.

This method of burning gas for incandescence is in practical use on the Continent, and is giving such excellent results that its use is rapidly spreading.

It was as early as 1894 that Daus took out a patent for the production of an intensely hot flame by the use of a mixture of gas and air, made by a suction air drum driven by the gas meter, which secured a constant mixture of the gas and air in the required proportions, and used the flame for heating Fahnehjelm combs. Later on Doller, Fuller, and finally the "Selas" Company took out further patents on improvements of the same idea, and under these combined patents have made a great success, the last installation being in the Thiergarten in Berlin, where the results attained are said to be exceedingly good.

The so-called "Selas" system consists of a small apparatus for the mixing of two volumes of air with one of gas immediately after leaving the consumer's meter, and it is worked by a small water motor using 1·2 litres or a little over a quarter of a gallon per burner per hour, or if desired it may be worked very cheaply by an electric motor.

The results obtained by this method, which is intended for use in the house, are that with a consumption of 3·53 cubic feet of coal gas in admixture with air a light of 134 English candles is obtained, whilst with a consumption of 4·24 of gas the light rises to 167·9 candles, or 39·5 per foot.

These results are obtained with Berlin, Stockholm, and Copenhagen gas, the illuminating power of which varies from 14 to 15 candles, whilst with a high pressure system on the same lines, but with a compressor as well as a mixer, over 45 candles per foot are obtained with the same low power gas. I have not tested the results myself, but the fact that they have been obtained by Mr. F. D. Marshall at the Copenhagen works is a sufficient guarantee of their correctness, and I hope Mr. Marshall will be able to give a paper and demonstration of these remarkable results at the next meeting of the combined Institutions.

A very interesting phase of high pressure illuminations which tends in the same direction, is to be found in some experiments made by Mr. R. G. Shadbolt on the effect of using air under pressure to suck in coal gas instead of the gas sucking in air. In order to do this, he removed the gas nipple from an ordinary injector burner, and supplied air instead of gas through it, and sucked in the gas through the side holes. He found that by passing air in at a pressure of 32 tenths (3·2 inches) he got a consumption of 18 cubic feet of 17 to 17·5 candle gas, and a duty from the mantle of 678·5 candle, or 37·69 candles per foot.

High pressure incandescent lighting is a means to attain a definite end, and that end is to create centres of high total illuminating value in order to compete with arc lighting for out-door work and large buildings. There is no doubt that the amount of light which can be obtained from the surface of a single mantle can be enormously increased thereby, but I do not think carefully made tests would reveal so great an economy in the units of light obtained per cubic foot of gas consumed as one would expect. I frankly admit that that the high pressure incandescent companies have not shown any burning desire to submit their systems to my tender mercies, so that I have no personal knowledge of the actual results they are obtaining, or the cost at which it is being done, but Continental practice has gone so far ahead of ours, that one can take a comparison of the candle units per cubic foot of gas consumed.

Probably the greatest volume of light obtained by high pressure incandescent gas lighting is in the "Millenium" burners, which, with a double mantle, give a light of 1,800 Hefner candles, obtained by a consumption of 1,566 litres of Berlin gas, *i.e.*, 28·5 candles per cubic foot.

In the Millenium burner, I understand, the gas is compressed under a pressure of over four feet of water, but one knows that over 30 candles a foot can be obtained with Berlin gas at lower pressures, such as 10 inches by the forms of apparatus in use here, but then the total volume of light is much smaller.

The value of mixing the coal gas with some of the air before compression, so as to get more thorough admixture, and then using this to suck in the extra air required is also clear, as Mr. Marshall found with the

"Selas" high-pressure system, that with Berlin gas and using a pressure of 24 inches of water he could obtain a light of 766 candles with a consumption of 16·7 cubic feet of gas, or 45·8 candles per cubic foot: and it is clear that by using lights obtained under this system over a large area, a great economy as well as a far better illuminating effect would be produced, as compared with half the number of lamps of double the candle power obtained by merely using gas compressed to 6 feet.

In considering the economy and utility of high pressure lighting, it must be borne in mind that, although it may be politic and necessary to use what are practically blowpipes rather than burners in order to create light which in volume shall compete with the electric arc, yet up to the present the mantle has not been made that will stand such usage for any great length of time. It is claimed for the Selas method of lighting that the life of the mantle is enhanced by 10 per cent. instead of being shortened, and if this be so, it would certainly accentuate its claim to rank before all other systems.

After all is said and done, however, the great and most important factor in incandescent lighting is the mantle, and we must now turn to that portion of the subject and see what improvements have been made and what improvements are likely to be made, as upon this so much depends.

Since the introduction of the present composition of 99 per cent. thoria and 1 per cent. ceria it is safe to say that no improvement has been made in the composition itself, and in this country but little improvement in the physical condition of the mantle, and although the introduction of the beautiful artificial silk processes of mantle making of Knofler, Plaissetty, and Lehner showed that it was possible to obtain a very considerable increase in the life and light emissivity of the mantle, yet with the cheapening of mantles that has taken place during the past year, it would not be possible for a mantle made on this principle to be sold at a price which would compete with mantles of the Welsbach type, such as now can be bought at 3d., or even less.

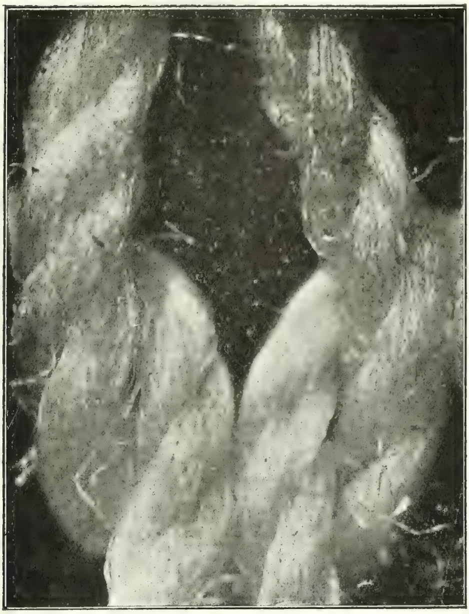
In a previous course of Cantor lectures I showed that the structure of the cotton mantle differed widely from that obtained by the various collodion processes, and that it was this alteration in structure that was mainly responsible for the increase in life. Whereas the average of a large number of Welsbach mantles tested, only showed a useful life of 700 to 1,000 hours, the collodion type would average about 1,500 hours, some mantles being burnt for an even longer period and still giving an effective illumination. This being so, it was clear that one line of advance would be found in obtaining some material which, whilst giving a structure more nearly approaching that of the collodion mantle, would at the same time be sufficiently cheap to be able to compete in the open market with the Welsbach mantle, and this I think has now been successfully done.

By the aid of photo-micrography the structure of the mantle can be clearly defined, and on examining the Welsbach mantle before and after burning, it will be noticed that the cotton thread is a closely twisted and plaited rope of myriads of minute fibres, whilst the collodion mantle is a bundle of separate filaments without plait or heavy twisting, the number of such filaments varying with the process by which it was made. This latter factor experiment showed to have a certain influence on the useful light-giving life of the mantle, as whereas the Knofler and Plaisetty mantles had an average life of about 1,500 hours, the Lehner fabric, which contained a larger number of finer collodion threads, could often be burnt continuously for over 3,000 hours, and at the end of that period gave a better light than most of the Welsbachs after as many hundred.

It is well known that the plaiting of the cotton candle wick gave it that power of bending over when freed from the binding influence of the candle material and influenced by heat, that brought the tip of the wick out from the side of the flame. This by enabling the air to get at it and burn it away, removed the nuisance of having to snuff the candle, which, for many centuries had rendered it a tiresome method of lighting. In the cotton mantle, the tight twisting of the fibre brings this principle of torsion into play. When the cotton fibres saturated with the nitrates of the rare metals are burnt off, and the conversion into oxides takes place, as the cotton begins to burn, not only does the shrinkage of the mass throw a strain on the oxide skeleton, but the last struggle of torsion in the burning of the fibre tends towards disintegration of the fragile mass, and I think this all plays a part in making the cotton mantles inferior to their collodion brethren.

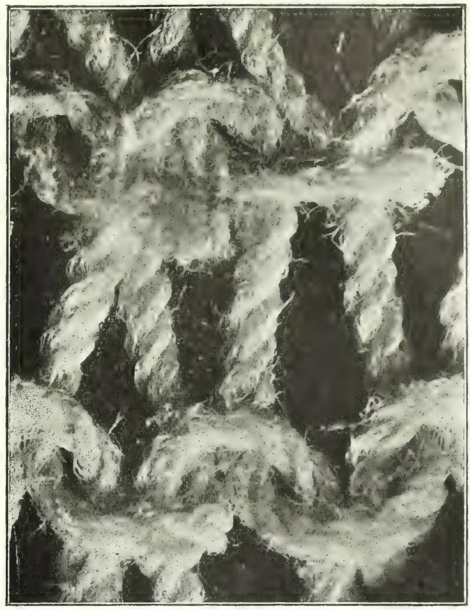
It has long been known that if ramie fibre be prepared in such a way as to remove from it all traces of the glutinous coating, a beautiful

FIG. 1.



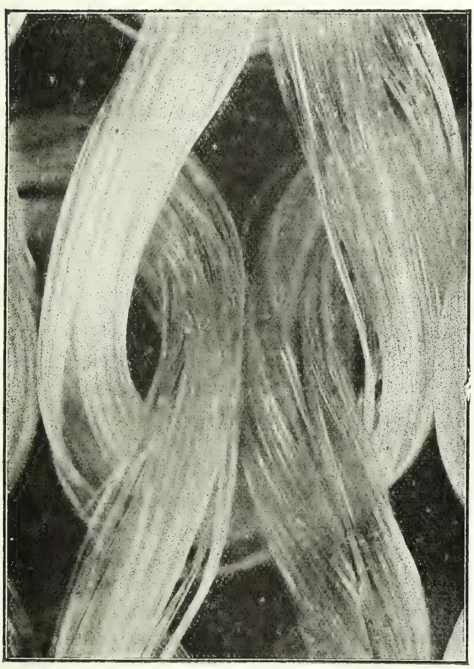
COTTON FABRIC (UNBURNT).

FIG. 2.



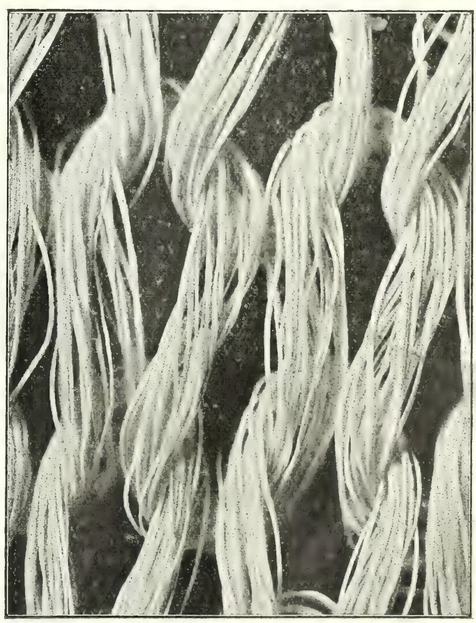
COTTON FABRIC (BURNT).

FIG. 3.



LEHUER COLLODICN FABRIC (UNBURNT).

FIG. 4.



LEHEUR COLLODION FABRIC (BURNT).

silk-like fabric can be obtained from it, and that if still further prepared so as to improve its absorbent powers, ramie mantles could be made with a life considerably greater than those of the cotton fabric. It seemed that this was a likely material to work upon in finding a cheap competitor in length of endurance to the collodion mantle, and a success has now been achieved in this direction which I think will play as important a part in the future of incandescent lighting as any improvement that has taken place.

Starting with ramie fibre, and treating it in such a way as to remove all the objections which at first militated against its use for mantle making, and then making it into threads with the least possible amount of twist, Herr Buhlmann, of Berlin, has at length succeeded in making a mantle fabric superior in every way to that given by cotton. As is well known, he has employed ramie for many years in mantle manufacture, but before the later developments in treatment were arrived at, the results were by no means what they should have been, and many of the ordinary "Krone" mantles introduced into this country did not show the improvement that was expected of ramie. These last improvements, however, mark a great advance, and Herr Buhlmann has at the same time invented an automatic process of burning and shaping the mantles, the effect of which cannot be overestimated.

In the old method of burning off and shaping a mantle, the impregnated cotton fabric, after drying and shaping on a glass mould, was burnt first by means of a bunsen flame, and was then shaped by a blast blowpipe, this being considered necessary to harden and strengthen the weakly filament. In the few automatic burning machines that have been devised this same lifting and lowering of the mantle over the blast blowpipe was employed, but it is impossible by any such means to get anything like uniformity in the condition of the ash or in the shape of the mantle, and yet Buhlmann has succeeded in getting both in the most simple and effective manner.

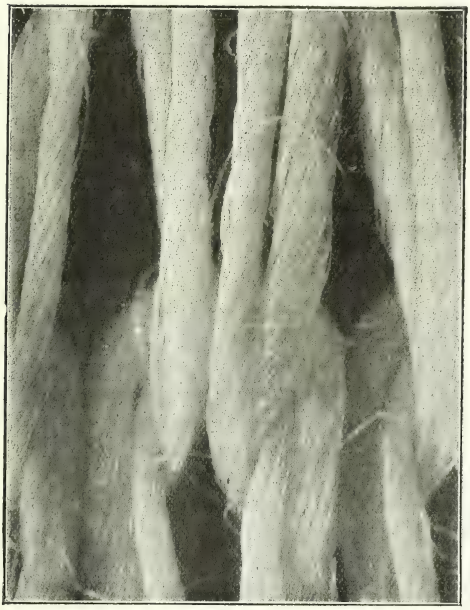
Many years ago I attempted to get uniformity in shape by making a burner head of the size and shape of the mantle required of platinum gauze, and by putting the mantle fabric over this tried to burn it down to the required dimensions. I found that there was no trouble in getting it to shrink satisfactorily down to the mould, but there it invariably stuck, and I was fortunate if I got a square inch of mantle off the platinum head, so I came to the conclusion that it was impossible to do this. However, Buhlmann's superior manipulative skill had led him to a well-deserved success. He makes model in iron wire gauze of triple thickness of the mantle that he requires, and mounts this on a burner tube to which the gas is supplied and into which air under pressure is blasted, giving in effect Mr. Shadbolt's idea of using the air under pressure instead of the gas. The result of this is that over the whole of the iron mould you have that green seething combustion that is such a factor in the inner zone of a well-regulated mantle flame, and the gas is burnt so rapidly that what would be the outer zone of an atmospheric burner flame is only a thin almost imperceptible layer above the sea-green sheath. The mantle in its unburnt condition is lowered automatically over this, a lever arm which lowers the mantle also turning on the right proportions of air and gas and starting a small sand glass. The ramie fabric burns away and the whole shrinks down until the green zone is reached, where the strong air blast that is causing this green zone prevents any further shrinkage. In the high temperature of the green zone the ash is baked and hardened for a definite period of time, marked by the running out of the sand. (*See* Fig. 8, p. 143.)

The burners are made up in batteries of the required number, and are all actuated by the same levers, so that the mantles are all put on, burnt off, and lifted off by the movement of the lever arm. The same action that causes the lifting off also turns off the gas and air blast. Nor is the extra burning needed to harden and strengthen the head neglected, for as soon as the mantle has shrunk to the mould, the lever brings down a ring blast on the crown of the mantle, so that none of the factors of success are omitted.

It will be seen from this description that the iron gauze head of the burner shapes the inner green zone of the flame, and that this in turn shapes the mantle, so that there is no chance of adhesion between the mantle and the mould, as the two never come in contact.

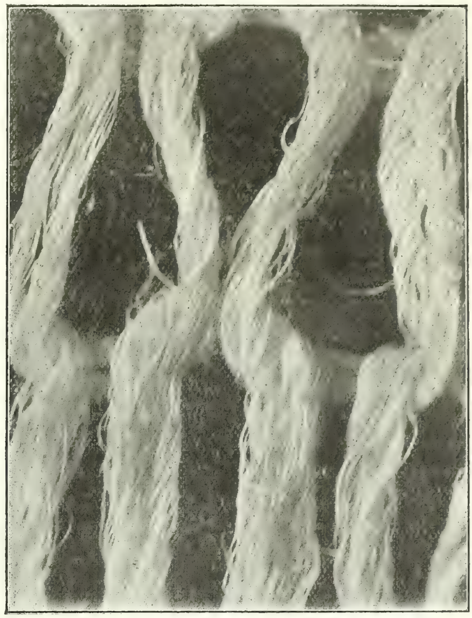
The result of this method of burning is to get a uniformity in size and shape and condition which it would be impossible to attain in any other way, and after having examined and fully tested this method of working the mantles in Berlin, I brought back to England with me two samples out of the number I had seen made. The asbestos loop of one unfortunately got fractured in travelling, but the other I was

FIG. 5.



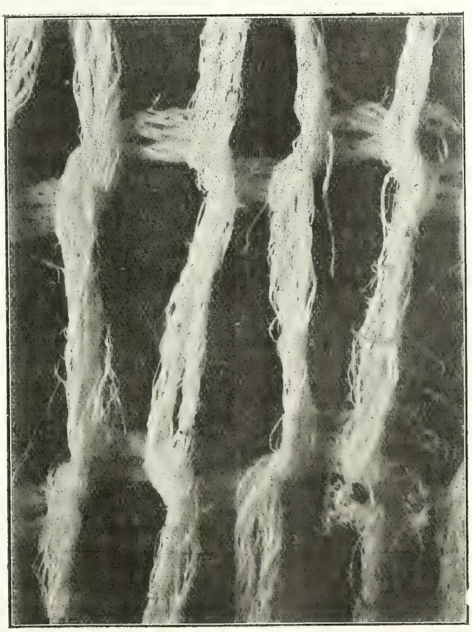
RAMIE FABRIC (UNBURNT).

FIG. 6.



RAMIE FABRIC (BURNT).

FIG. 7.



RAMIE MANTLE (AFTER BURNING 3,264 HOURS).

enabled to test for endurance and light-giving power. On the ordinary Welsbach "C" burner it gave a candle power at first of little over 60 candles, but to my astonishment, as week after week rolled by, the photometer indicated no decrease in the initial candle power, and for over 3,000 hours, *i.e.*, from May 28th until October 10th, when it was accidentally broken in removing a cracked glass, it continued to give a light of 60 candles for a consumption of 4 cubic feet of gas at a pressure of 12-10ths.

This result is the most extraordinary one I have ever obtained. The tests were taken every ten days or fortnight, and the mantle had to stand the jars and jolts of being taken from the chamber in which it was burning to the photometer and back. Yet through the whole period it led a practically curveless life, and, to all appearance, had it not been for its violent end, might have gone on for a considerably longer period.

The mantle so tested and giving these wonderful results contained a rather higher proportion of the oxides, *i.e.*, the ash was a rather heavier weight, than the mantles in ordinary use for lighting in Berlin, which give a higher initial illuminating value of 80 to 90 candles at the start, and sink to about 72 candles after 600 hours, and then continue with but little loss of light. The result, however, shows that by this system uniformity of light as well as shape can be obtained.

I am inclined to believe that this marvellous increase in life is not altogether brought about by differences in the ramie ash, the conditions of twist in the thread, and the number of fibres present in the thread, but is also largely due to the method of burning.

When an ordinary mantle is being burnt off, as is done by the Welsbach process, it is shaped and seasoned, *i.e.*, blasted in a high pressure blowpipe, and the light emitted is so intense that coloured glass screens have to be used by the girls in the works. I have always felt that this high temperature treatment was a mistake, as it vitrifies the filament and renders it brittle. It also apparently uses up a very large proportion of the light-yielding factor in the mantle.

In the automatic burning of the Buhlmann mantle, however, the fabric is quietly and gently shaped and shrunk down to the mould head that gives it the required size and shape, and in this proportion practically no light is emitted by the oxided filaments. Yet the mantle so produced shows an elasticity and power of keeping up its illuminating value which I should never have considered possible.

On now examining the ramie fabric, the great differences which exist between it and the cotton fabric are at once apparent, and it will be noticed that it approaches much more nearly to the physical condition of the collodion mantles.

Dr. Killing, who has also used microscopic enlargement as a method for investigating the variations in mantles, has come to the conclusion that the cotton thread consists of about 270 single fibres, whilst the ramie thread made in this way has only about 90 single fibres. The transverse section is therefore much greater with the ramie than with the cotton, and this remains *pro rata* the same after the impregnated material has been burnt off. In other words, the ramie thread contains only one third the number of fibres that the cotton thread does, but each fibre is three times as thick as that of the cotton, and therefore melts and is destroyed by the heat of the flame less easily than the thinner thread of oxide derived from the cotton fabric. As the fine ash fibres from the cotton fabric fuse more easily together, the lighting power of the mantle made in this way decreases far more rapidly than that yielded by the other type.

On examining the structure of the mantle which had been burnt for over 3,000 hours, and comparing it with the structure of a freshly burnt off mantle, Dr. Killing's view is thoroughly supported, as it will be seen that each fibre remains perfectly separate, and no signs of fusion into a solid mass can be seen.

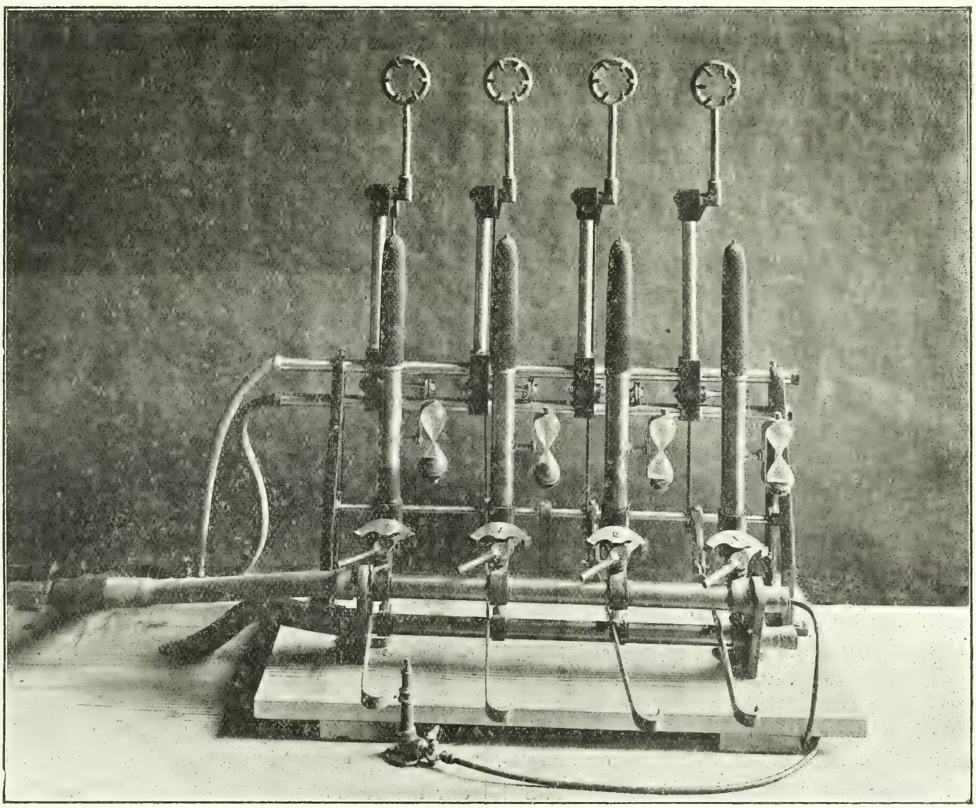
Whilst inspecting the process of burning off I took the opportunity of calibrating a large number of the mantles present in the drying-room, and found an absolute uniformity in size and shape. The effect of this cannot be over-rated. It is not difficult to get burners giving a uniform shape to the flame, and with these absolute uniformity of result can be obtained, so that instead of seeing a long street lighted by incandescent mantles, some giving an illuminating value of 100 candles, whilst others are contenting themselves with a modest 25, a uniform effect can be arrived at, and with the length of life that I have indicated, an enormous advance in the position of incandescent lighting would take place.

Another direction in which the future of coal gas will benefit largely, by a cheapening in price owing to economies in manufacture and distribution, will be for use as a fuel. Already the ever-increasing demand made upon the

metropolitan gas companies during the day marks the advance of the utilisation of coal gas for cooking, heating, and power, so that whilst the increase in the amount of gas used at night is only rising by some 3 per cent. annually, the day consumption shows an increase of 16 per cent. Directly it becomes possible to reduce the price of the gas to about 2s. a thousand, advance on these lines will become extremely rapid, and the gas companies are naturally doing everything in their power to foster this development. It is, however, necessary, in order further to popularise gas as a fuel, that everything that can be done should be done to remove any prejudices that exist against heating by gas.

There are many excellent gas stoves on the market, well designed, and giving high heating duty for the gas consumed, but there are also many that, both in their performance and in their effect on the atmosphere, are radically bad. Now that the gas companies have so largely taken over the sale and pushing of gas heating apparatus, it is a duty they owe to themselves and to their customers to take care that only stoves of scientific construction and good efficiency should be supplied. Many of the worst stoves are the most ornate, and for that reason find their way into many homes, as they in the first place appeal to the eye of the housewife, and afterwards to the nose and health of the household, and the result is that a good customer is converted into an enemy of gaseous fuel. No gas fires should be sold or let on hire that do not do a large proportion of the heating by radiation, and a gas company that sells a flueless gas stove, save for hall or passage heating, should be prosecuted.

FIG. 8.



BUHLMANN'S AUTOMATIC MANTLE MACHINE.

A cubic foot of coal gas on its complete combustion yields ·52 cubic feet of carbon dioxide and 1·30 cubic feet of water vapour, and if you do not mind breathing hot polluted air, highly charged with water vapour, and getting chilled with cold walls, a Bunsen burner stood on

floor is the most effective method of getting the whole of the heat of combustion into the air of the room, and no flueless stove can do more than this. In order to get something to sell, stoves are constructed in which some of the water is condensed, and the public are gravely informed that this removes all deleterious products. But it is impossible to get away from the fact that if healthful heating is to be obtained, it is the solid objects and walls of the room that must be heated, and not the air, and that although some of the heat is lost thereby, a flue to take off all products is an absolute essential.

The gas companies have it in their power to govern the gas stove trade, and unless they choose to take the initiative, it will retard the popularity of heating by gas to a most serious degree. With all stoves in which solid bodies like asbestos are heated by atmospheric burners, a trace of carbon monoxide is always produced, and if there is not a proper flue passing well into the chimney, a headache is added to the other discomforts.

Improvements in gas motors and gas engines are steadily going on, and as soon as the price of coal gas can be reduced sufficiently to attract this class of custom, a wide field will be opened up for it.

The development of large gas engines during the last few years gives promise of an entire revolution in our methods of procuring power, and it is highly probable that within a very few years the gas engine will make great inroads upon the generation of power by steam. Already gas engines up to 1,500 horse-power have been constructed, whilst engines of over double that power are under construction.

In England, Messrs. Crossley Bros. and other well known makers are producing a very large number of such engines for driving dynamos, whilst it is stated that on the continent Messrs. Horting Bros. have made or have under construction 32 gas engines, with a total of 44,500 horse-power, averaging 1,390 horse-power each engine, and the John Cockerill Company and several German companies follow not far behind.

With such a development of gas for motor purposes, it is manifestly the policy of the gas companies to make a determined bid for so wide a field of output, and if they can supply a clean heating gas with 460 to 500 B.T.U.'s heating power, it is clear that the convenience of doing away with separate generating plant would cause a large proportion of this business to fall to their share, if the price of the coal gas could be made to compete with a fuel gas of only 150 B.T.U.'s, that is to say, if nearly the same number of calories could be obtained by its use at the same cost.

Taking the imperfect review of the possibilities of the future and the teachings of the past, what conclusions are we to draw as to the gas of the future? My own opinion is that it will be a 12 candle gas, made by mixing blue water gas with coal gas, the blue water gas being introduced either into the foul main or used as an aid to distillation, so as to do away with any need for enrichment. This gas will have a calorific value of not less than 460 B.T.U.'s nett, and a selling price of not more than 2s. a thousand, the economies necessary to reach this lower price being brought about by making the gas in the holder at 9d. to 9½d. a thousand, and distributing at a considerably increased pressure, the pressure being regulated down to 1½ inches at the entrance to the consumer's meter.

Gas fittings should be entirely taken over by the gas companies, who should supply incandescent fittings and mantles, and keep them in order at a small yearly rental; and where swinging brackets and other causes demand flat flame burners, the companies should fit nipples with broad slits regulated to burn at the lowest possible pressure.

The reduction in price cannot be made at once, but as the cost of production permits, a reduction of price on gas used for fuel and power purposes should be made first in order to expand consumption in that direction, and by levelling the load, to prevent the necessity for the increase of holder accommodation at the same rate as the increase in consumption, whilst the increase in pressure will do the same thing for the mains.

As time passes on the candle power of the gas may be reduced to 10 candles, and the time will be ripe for radical changes in our methods of carbonisation, which will then follow more on the lines of the coke oven illuminating gas plants now being introduced in America.

Correspondence.

THE SOUTH RUSSIAN IRON INDUSTRY.

Mr. Bennet H. Brough writes:—Having been prevented from attending the meeting, I have read Mr. A. P. Head's exhaustive paper in the *Journal* with very great interest and profit. The growth of the South Russian iron trade has undoubtedly been

remarkably rapid, and the present depression is exceptionally acute. Mr. Head gives some well-considered hints for relieving this depression. He does not, however, indicate two directions in which the South Russian ironmaster might possibly turn his attention with advantage. Russia produces more manganese ore and more petroleum than any other country in the world. Would it not be possible to utilise more extensively these valuable products on the spot, by developing the manufacture of spiegeleisen and ferromanganese, and by increasing the employment of petroleum for metallurgical purposes? Remarkable as the figures given by the author showing the comparative production of pig iron in 1899 are, they are less striking than later statistics. In 1901, when Russia produced 2,831,000 tons of pig iron, the United States produced 15,878,354 tons, the United Kingdom 7,928,647 tons, and Germany 7,860,893 tons. Similarly, the latest South Russian statistics show more clearly than the figures given by the author the present plight of the iron and coal industries. The report presented at the meeting of ironmasters at Kharkoff last month gives particulars of the South Russian production during the year ended on September 1st, 1902. During that period the Donetz coalfield yielded 9·4 per cent. less than the production of the previous year, a diminution unprecedented in the history of the coalfield. The production of coke showed a decrease of 11·3 per cent., and the production of pig iron a decrease of 2·75 per cent. On September 1st, 1902, of the 56 blast furnaces in South Russia, only 23 were in operation. The output of iron ore was, in conseqence of the crisis in the iron trade, notably reduced. Only 48 of the 79 mines at Krivoi Rog were at work. A comparison between the possible productivity of the district and the production during the year, affords a clear indication of the depression. The collieries furnished only 59 per cent. of their possible output, the coke ovens 42 per cent., the blast furnaces 55 per cent., and the Krivoi Rog mines 37 per cent.

Mr. W. H. HERDSMAN (Messrs. Edward Riley and Co.) writes to Professor Le Neve Foster, F.R.S. :—At the Society of Arts' meeting last week, I listened to Mr. Head's very interesting paper, and also to your remarks on the same, but had to leave before the conclusion of the discussion. Having myself visited, last summer, the several districts in question, I think Mr. Head's description of the ore bodies as "boat-shaped" is calculated to convey a better mental idea of their real character than is the word "lenticular." I agree, however, with you that the Kertch iron ore deposits are in all probability much larger, and likely to prove of greater importance, than those of Krivoi Rog. Apparently Mr. Head had not visited them, or he would not say they are not important. The friability of the Donetz coal is no doubt a natural quality, quite independent of the weather, and Mr. Head's explanation of the cause seems to me to be a very feasible one. My recent three months' tour in Russia also included a visit to the Caucasian manganese deposits at Tchiatouri, for the purpose of comparing them with the Brazilian deposits, all of which are personally known to me. I am in full agreement with yourself and Mr. Head as to the cordiality with which Englishmen are received in Russia, and regret the imperfect understanding which exists in England respecting that country and its people.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock :—

JANUARY 14.—"Industrial Trusts." By PROF. W. SMART, LL.D. SIR ROBERT GIFFEN, K.C.B., LL.D., F.R.S., will preside.

JANUARY 21.—"The Metric System." By A. SONNENSCHEIN. ALEXANDER SIEMENS will preside.

JANUARY 28.—"The Cost of Municipal Trading." By DIXON H. DAVIES. The LORD CHIEF JUSTICE, G.C.M.G., will preside.

FEBRUARY 4.—"Methods of Mosaic Construction." By W. L. H. HAMILTON.

FEBRUARY 11.—"The Port of London." By Dr. B. W. GINSBURG.

FEBRUARY 18.—"Three-Colour Printing." By HARVEY DALZIEL. CARMICHAEL THOMAS will preside.

Dates to be hereafter announced :—

"Existing Laws, By-laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions." By T. BRICE PHILLIPS. (Fothergill Prize Essay.)

"Oil Lighting by Incandescence." By ARTHUR KITSON.

"The Use of Electrical Energy in Workshops and Factories." By ALFRED C. EBORALL, M.I.E.E.

"Modern Bee-Keeping." By WALTER FRANCIS REID, F.C.S.

"Tonkin, Yunnan and Burma." By FRED. W. CAREY, late H.B.M.'s Acting-Consul at Szemao, China.

"Education in Holland." By J. C. MEDD.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

JANUARY 22.—"Indian Domestic Life." By JOHN DAVID REES, C.I.E. The LORD HARRIS, G.C.S.I., K.C.I.E., will preside.

FEBRUARY 26.—"Gleanings from the Indian Census." By JERVOISE ATHELSTANE BAINES, C.S.I.

MARCH 12.—"The Currency Policy of India." By J. BARR ROBERTSON. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

APRIL 23.—"The Province of Sind." By HERBERT MILLS BIRDWOOD, C.S.I., M.A., LL.D.

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D.

Colonial Section.

Tuesday Afternoons, at 4.30 or 5 o'clock :—

February 10, at 5 p.m.—"Women in Canada." By the Countess of Aberdeen.

March 3, at 4.30 p.m.—"The Uganda of To-day." By Herbert Samuel, M.P.

March 31, at 4.30 p.m.—"British North Borneo." By Henry Walker, Commissioner of Lands, British North Borneo.

May 5, at 4.30 p.m.—"Preservation of the Species of Big Game in Africa." By E. North Buxton.

Applied Art Section.

Tuesdays, at 4.30 or 8 o'clock.

January 20. 8 p.m.—"Principles which should guide all Applied Art." By G. F. Bodley, R.A.

February 3. 4.30 p.m.—"Technical Education in connection with the Book-producing Trades." By Douglas Cockerell.

February 17. 8 p.m.—"Heraldry in Decoration." By George W. Eve, A.R.E. Lewis Foreman Day will preside.

March 17. 4.30 p.m.—"Artistic Fans." By Miss Hannah Falcke.

May 19. 4.30 p.m.—"The Mounting o a Play" (Stage Costumes and Accessories). By Percy Macquoid, R.I.

Cantor Lectures.

Monday Evenings, at Eight o'clock :—

Julius Hübner, "Paper Manufacture." Four Lectures.

Lecture I.—February 2.—History—Cellulose—Raw materials—Boiling, washing, breaking, and bleaching of rags—Esparto—Straw.

Lecture II.—February 9.—Soda recovery—Manila hemp—Jute and other raw materials—Mechanical wood—Wood cellulose—Beating—Sizing—Loading—Colouring.

Lecture III.—February 16.—Stuff-chest—Regulator — Sand-tables — Strainer — Hand-made paper—Fourdrinier paper machine.

Lecture IV.—February 23.—Single cylinder and other types of paper-making machines—Finishing — Cutting—Statistics—Paper-testing—Experimental paper making.

Prof. J. A. Fleming, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." Four Lectures.

March 2, 9, 16, 23.

W. Worby Beaumont, Mem.Inst.C.E., "Mechanical Road Carriages." Four Lectures.

April 27, May 4, 11, 18.

MEETING FOR THE ENSUING WEEK.

Monday, Jan. 12...Cyclists' Touring Club (Metropolitan Section), (at the House of the Society of Arts), 7½ p.m. Address by Sir Martin Conway.

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. H. T. Scoble, "Rural Drainage and Sewage Disposal."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Camera Club, Charing-cross-rd., W.C., 8½ p.m. Dr. T. Glover Lyon, "Pure Air, without Draughts."

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-cir E.C., 5 p.m., Rev. W. H. Dallinger, "Re Studies in the Lives of Spiders."

Tuesday, Jan. 13...Royal Institution, Albemarle-street, W., 3 p.m. Professor A. Macfayden, "The Physiology of Digestion." (Lecture I.)

Medical and Chirurgical, 20, Hanover-square, W. 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. H. F. Joel, "Electric Automobiles."

Photographic, 66, Russell-square, W.C., 8 p.m.

Anthropological, 3, Hanover-square, W., 8 p.m.

Colonial, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Mr. W. A. Hickman, "The Canadian West and North-West."

Wednesday, Jan. 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Prof. W. Smart, "Industrial Trusts."

Japan Society, 20, Hanover-square, S.W., 8½ p.m. Mr. W. Crewdson, "The Dawn of Western Influence in Japan."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

Archæological Association, 32, Sackville-street, W., 8 p.m.

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Thursday, Jan. 15...Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Rev. W. Marshall, "The Romance of Architecture."

Royal Institution, Albemarle-street, W., 3 p.m. Dr. A. J. Evans, "Pre-Phœnician Writing in Crete, and its Bearings on the History of the Alphabet" (Lecture I.)

Mining and Metallurgy, at the Rooms of the Geological Society, Burlington-house, W., 8 p.m. 1. Mr. E. Henry Davies, "Notes on Copper Mining in the Vale of Avoca, County Wicklow, Ireland." 2. Mr. G. H. Blenkinsop, "Notes on the Berehaven Copper Mines." 3. Mr. A. J. MacInerny, "Notes on an Iron Property near Tunis."

Historical, Clifford's-inn, Fleet-street, E.C., 5 p.m. Mr. A. Savine, "The Bondmen of the Elizabethan Age."

Numismatic, 22, Albemarle-street, W., 7 p.m.

Optical, 22, Hanover-square, W., 8 p.m.

Friday, Jan. 16...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. Dewar, "Low Temperature Investigations."

Civil Engineers, 25, Great George-street, S.W.. 8 p.m. (Students' Meeting.) Prof. W. C. Unwin, "The Measurement of Water."

Mechanical Engineers, Storey's-gate, S.W., 8 p.m. Mr. H. F. Donaldson, "Cutting Angles of Tools for Metal Work as Affecting Speed and Feed."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Saturday, Jan. 17...Royal Institution, Albemarle-street, W., 3 p.m. Sir Frederick Bridge, "The Bi-Centenary of Samuel Pepys: His Musical Contemporaries, Criticisms, and Compositions." (Lecture I.)

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FRIDAY, JANUARY 16, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Tuesday, January 20, 8 p.m. (Applied Art Section.) G. F. Bodley, R.A., "The Principles which should Guide all Applied Art."

Wednesday, January 21, 8 p.m. (Ordinary Meeting.) A. Sonnenschein, "The Metric System." Alexander Siemens in the chair.

Thursday, January 22, 4.30 p.m. (Indian Section.) John David Rees, C.I.E., "Domestic Life in India." Lord Harris, G.C.S.I., K.C.I.E., in the chair.

Further details of the Society's Meetings will be found at the end of this number.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

"THE FUTURE OF COAL GAS AND ALLIED ILLUMINANTS."

By Professor Vivian B. Lewes,
Royal Naval College, Greenwich.

Lecture IV.—Delivered December 15th, 1902.

The title of "Allied Illuminants" presupposes a closer relationship than the mere fact that different substances are utilised for the production of light, and certainly no bond of alliance could be closer than that which exists between coal gas and oil as illuminants.

Born and bred in the same cradle, they have walked hand in hand ever since, as it was whilst Lord Dundonald was first distilling coal in order to obtain coal naphtha from it that he also made coal gas, and although at that period interest in the liquid illuminant caused its gaseous brother to be overlooked, the work of Murdoch and the puffing of Winsor put coal gas into a position which caused it to outshine the liquid twin.

In treating of oil lighting, as existing in the immediate past, and as destined to play an important part in the future, it is clear that the animal and vegetable oils, which were much in evidence in illuminating the dark ages, and forming a twilight to the brilliant illumination of the past century, may be disregarded; so that, considering only mineral oils, the relationship existing between coal gas lighting and oil lighting is the closest that one can conceive.

If certain classes of coal be distilled at a comparatively low temperature, we obtain oil, and if other classes are distilled at a high temperature we obtain coal gas. For the past twelve years oil gas has played so important a part in the carburetting of coal gas that the relationship between them becomes still more inseparable.

In some parts of the world nature in her prodigality supplies natural gas, and even in this country some is to be found, for there are not wanting those who look forward to Sussex becoming a Pennsylvania on a small scale. However, natural gas is small in quantity as compared with the natural sources of mineral oil, and this gives the latter illuminant a distinct advantage.

The advent of the coal gas industry in the early twenties provided tar from which light oils could be obtained by distillation, and the consumption of these in the Read-Holliday lamp has ever since been a favourite source of light for the coster and the travelling showman. In this lamp the principles which underly many of our most modern developments for burning oil for heating and lighting are to be found, as it is a wickless lamp which gasifies the coal tar naphtha that yields the flame, the flame itself providing the necessary heat to keep the supply of gas constant. Other lamps of the same type are also made for the consumption of oils of higher flash point, but although of great utility in illuminating open spaces, the danger of a leakage of burning oil and the slight irregularity in the supply of oil to the vapourising chamber render them unfit for use in buildings containing inflammable materials.

The Read-Holliday lamp was practically the only mineral oil lamp existing up to the middle of the last century, and 1850 marks the birth of the great mineral oil industry. In 1847, James Young, whose name is as indelibly connected with mineral oil lighting as is that of Murdoch with coal gas, discovered, or had pointed out to him, a leakage of oil from a seam in the Riddings Colliery at Alfreton. Collecting this, he succeeded in preparing from it by distillation a valuable lubricant; but the demand for it very soon exceeded the supply that he could obtain, and in his attempts to keep pace with the trade he had created, he found that the same oil could be obtained by the distillation of certain grades of shale. Hence arose the Scottish oil industry.

The purpose for which the oil was obtained was at first purely that of lubrication, and the light oils distilled off from the heavier ones which were fitted for this purpose were practically a waste product. Although some attempts were made to utilise the lighter distillates for burning in a lamp, no practical results were obtained until 1853, when it was noticed that this oil was being bought at a very cheap rate, and was being exported to Hamburg. Curiosity being aroused, it was found that the oil was being used in Germany in lamps made by Stohwasser, of Berlin. This led to the introduction of these lamps into England, where they were afterwards manufactured, with improvements, by Messrs. Laidelaw, in Edinburgh.

It was in 1859 that commercial circles in America were convulsed by the fever of speculation roused by Colonel Drake succeeding in obtaining petroleum by boring in districts where previously it had merely occurred as a scum on the surface of stagnant water, and the next year or two resulted in the flooding of the market with oil at prices never before deemed possible. This led to the introduction of lamps from Germany for its consumption, but American ingenuity soon led to many improvements, and from 1859 to 1879, something like 1,600 patents were taken out for lamps fitted for the consumption of oil.

Nor was America alone in its efforts to improve the methods for the consumption of mineral oil. Some of the most distinct advances in this direction were made in England by such workers as Messrs. Hincks, Silber, and Defries, with the result that we have to-day lamps for the consumption of oil that develop from it an amount of light undreamt of in the early days of the oil industry, whilst the advances in the manufacture of the oil lamp have been accompanied by the discovery of oil deposits in every part of the world.

As the oil leaves the well it is a mixture of many hydrocarbons, mineral oils even varying amongst themselves in the class of hydrocarbons which are present in them. The crude oil has then to be subjected to a rough fractional distillation, which yields first of all such easily volatilised products as petroleum spirit and the low flash point oils, whilst those distillates that have a flash point of over 73° Fahr., and yet are of sufficient mobility to be fed with regularity by the capillarity of the wick to the flame, come under the heading of lamp oil, and are utilised in the ordinary mineral oil lamp.

In the burning of such oil it is drawn up by the wick from the lamp reservoir into the zone of heat created by the combustion, and is there converted into a gaseous mixture of hydrogen and hydrocarbons which yield the flame, whilst the actions going on within the flame yield the light which is emitted before the complete conversion by combustion of the flame gases into carbon dioxide and water vapour, the ultimate products of complete combustion.

In order to secure the best results with the combustion of oil in a lamp, it is necessary to devote special care to several factors, so that the lamp shall burn with a smokeless flame of as high illuminating power as possible, and emit only the products of complete combustion.

One of the most important points is the wick,

by which the oil is fed to the flame, and the amount of oil so supplied must be carefully regulated, as if the oil be in excess the air supplied to the flame is unable to burn it completely, with the result that the lamp smokes and products of incomplete combustion are formed, whilst if the flame be starved, the loss of light is very great. The quality of the wick, moreover, demands careful attention, and it should be woven loosely from a coarse thread made of long staple cotton, and with as little twist as possible. The wick before use must be well dried, and when in position in the lamp must just fill the wick holder without being compressed, and should be of sufficient length to reach to the bottom of the oil reservoir and leave an inch or two on the bottom.

If the oil reservoir be not too deep, a wick of the above character will feed the oil to the flame in a uniform manner, but as all the oil passes through the wick, it is evident that any solid impurities in the oil will be filtered out and choke the capillaries upon which the action of the wick depends, so that after a time the choked wick must be thrown away and a new one inserted, this being done when an inch or two of wick has been burnt away.

During the first few moments after lighting the lamp the oil burns with a heavy smoky flame, on account of its being unable to get the necessary oxygen for its complete combustion; and soot, together with other injurious and malodorous products of incomplete combustion, escape into the air. To remedy this an artificial current of air has to be created, which shall supply the requisite amount of oxygen to complete the combustion, at the same time giving rigidity to the flame, and by ensuring the combustion taking place in a shorter space of time and so increasing the calorific intensity, raising the carbon particles to a high degree of incandescence. This can be done in two ways, first by the aid of a chimney by means of which the heated products of combustion draw in the air at the base of the flame, and secondly, by creating a draught from a small clockwork fan in the base of the lamp. The direct impact of this current of air, however, would cause the flame to be very unsteady, so that its uprush is checked by placing in its path perforated screens of metal and similar contrivances, by which an even supply of air is ensured which is deflected where required on to the flame by suitable metal discs and cones.

The economic advantages claimed for the oil lamp are, of course, based upon the amount of light that can be developed by the combustion of the oil. The most generally accepted estimate of this important factor is that given by Dr. Boverton Redwood, who states that the oil consumption with duplex burners giving a duty of about 28 candles, averaging 50 grains per candle per hour, whilst with argand burners with a duty of 38 candles, it is about 45 grains per candle per hour. It must be remembered, however, that although these are reliable results for the best types of lamp, the figures by no means represent the duty obtained by the ordinary consumer in daily practice from all types of lamp.

The results obtained from a selection of the lamps in use to-day are shown in the following Table:—

Type and Name.	Grains of oil per candle power per hour.		Total candle power.	
	American.	Russian.	American.	Russian.
Circular wick—				
Veritas (60 line)	64·5	112·5	112·5	78
,, (30 line)	42·5	50	60	60
,, (20 line)	43·75	58·5	40	35
Ariel (12 line), centre draught	52·8	70·9	18	18
Reading (14 line)	97·9	85·4	12	12
Kosmos (10 line)	63·9	97·2	9	9
Wizard (15 line)	56·9	51·3	18	19
Flat wick, single				
Wanzer (no glass)	42·6	48·3	17	15
Solid slip gauze and cone	84·4	84·4	8	8
Old slip, fixed gauze	60·9	89·3	7	7
Flat wick, duplex—				
Feeder wick ..	56·2	55·7	20	22
Ordinary	51·2	46·6	20	22

American oil—Sp. Gr. 0·7904; flash point, 110°F.
Russian oil—Sp. Gr. 0·823; flash point, 83°F.

It will be noticed from this that with the flat flame lamps of the type first introduced the American and Russian oil give practically the same result, whilst with the circular wick lamps the American oil appears to have a great advantage over the Russian. After prolonged burning, however, this difference is considerably lessened, and the same sort of results are to be found in the consumption of American and Russian oil in heating stoves.

Very little attention has been given to the amount of heat emitted by our illuminants, whereas it places a distinct limit upon the size and illuminating power of oil lamps, for

although the illumination yielded by, say, the Veritas 60 line is very good, yet the heat given off would be absolutely insupportable in a dwelling room.

Taking the composition of lamp oil as being 86 per cent. carbon and 14 per cent. hydrogen, the combustion of one pound would give 47,056 B.T.U.'s, while 50 grains, yielding one candle of illumination, would give 336 B.T.U.'s.

One cubic foot of coal gas gives on an average 620 B.T.U.'s, and the following results are obtained on calculating the amount of heat emitted per candle by various forms of burner:—

B.T.U.'s developed per Candle per Hour.

Oil lamp	336
Gas—Flat flame (No. 4 union jet)	310
Argand	207
Regenerative	88
Incandescent mantle	36·4

The advantages to be gained by the use of oil as an illuminant are most evident in country districts, where, as a rule, coal gas is dear, whilst its popularity would be even greater than it is were it not for the number of accidents that have occurred in the use of lamps.

The risk of accidents could be reduced to a minimum if certain types of lamp could be done away with and people educated up to the proper use of oil for lighting purposes. All the cheap lamps, and those with side feeds and glass reservoirs, should be rigorously banned, and when burning it should be remembered that a lamp must not be moved from its place, whilst the flames should be extinguished, not by blowing down the chimney, but by turning the wick down and then blowing across the chimney.

We have seen that the introduction of the incandescent mantle has had an effect on the gas industry of the world that cannot be overrated, and it was natural therefore that its application to the flame produced by the gas of oil instead of the gas of coal should soon be attempted. It is clear that, inasmuch as oil gas and oil vapours only differ from coal gas in the larger proportion and greater complexity of the hydrocarbon molecules present, it only needs a sufficiently large proportion of air to be mingled with the oil gas or vapour before combustion to make the flame available for the same method of developing light.

The difficulties which exist in attaining this end are, however, very great, as the very richness of the hydrocarbons renders it a matter of considerable difficulty to get the necessary amount of air thoroughly mixed with the gas.

A non-luminous flame can be obtained by burning a mixture of 1 volume of coal gas with 2·27 volumes of air; but if the flame be superheated, a certain proportion of luminosity will re-appear, as the increased temperature causes the decomposition into carbon and hydrogen of the hydrocarbon molecules in the gas, which could not take place when the gas was cool, owing to their separation and dilution with air. If a mantle be placed on such a flame, the superheating caused by the mantle itself will soon tend to the decomposition of the hydrocarbons in the gas, with the result that the mantle is blackened and rapidly destroyed. An increased proportion of air, however, entirely alters the flame, and the hydrocarbon molecules being burnt up before impact with the heated surface of the mantle, all chance of blackening is avoided.

With the flame yielded by gasified or vaporised oil this trouble proved to be a serious one, as although it was an easy matter to obtain a non-luminous flame, yet blackening made its appearance directly the mantle was placed over it, whilst if a further supply of air was brought into the flame, the flame required constant attention, a factor which was quite sufficient to prevent its adoption in daily practice.

Another source of trouble was found in the wick, the slightest irregularity of which seriously interfered with the correct working of the lamp, and it is by no means an easy matter to obtain a wick that is perfectly symmetrical, so that the wick was relegated to the duty of drawing the oil up into a vapourising chamber where the oil gas was produced, which, on then being mixed with air, gave the flame.

In the earlier types of incandescent oil lamps, a circular wick was generally used to bring the oil to within a short distance below the burner head, and at this point the oil was vapourised by the heat conducted from the flame by the metal of the burner. A central tube furnished one air supply, whilst a second was so arranged as to discharge itself almost horizontally on to the burning gas at the base of the flame, resulting in a non-luminous and very hot flame. The necessity for careful and constant attention, however, and the irregularity of their performance prevented these lamps from attaining commercial success.

An ingenious lamp was devised, in which oil and water were vaporised by the heat of a

little oil lamp in a lower and separate chamber, and the mixture of oil gas and steam was then burnt in a burner head with a special arrangement of air supply, heating a mantle suspended above the burner head.

The perfect petroleum incandescent lamp, however, on any of these systems has not yet been made, but with one lamp with which I experimented it was easy to obtain 3,500 candle hours per gallon of oil, or three times the amount obtainable from the oil when burnt under ordinary conditions.

As early as 1885 Mr. Arthur Kitson attempted to make a burner for heating purposes on the principle of injecting oil under pressure from a fine tube into a chamber where it would be heated by the waste heat escaping from the flame below. The vapour so produced was then made to issue from a small jet under the pressure caused by the initial air pressure and the expansion in the gasifying tube. This jet of gas was then led into what was practically an atmospheric burner, and it drew in with it sufficient air to ensure its combustion with a non-luminous blue flame of great heating power.

At this date the Welsbach mantle was yet in its infancy, so that a mantle of platinum wire was at first used to obtain the light from this flame, but like all other platinum mantles, although the light at first was very fine, yet the illuminating power rapidly fell off owing to the action of the flame gases on the platinum. The perfecting of the Welsbach mantle, however, gave the finishing touch to this method of consuming the oil, and the Kitson lamp has now attained an assured success, the only drawback being that its use demands a certain amount of intelligent care. Where this, however, has been forthcoming, the lamp has fully answered the high expectations formed for it.

In this lamp, as used for street lighting, the oil reservoir is in the base of the pillar; it is made of steel and tested to a high pressure in order to ensure its being absolutely safe at the pressure at which it is used. A small pump enables the oil to be put under a pressure of air amounting to 50 to 60 lbs., by which it is forced up through a small capillary tube to the burner head. Here it passes through a small cross tube containing filtering material, for removing any solid particles in it, and it is then ejected through a small aperture into a lower cross tube placed immediately above the top of the mantle, the heat from which, passing upwards, causes vaporisation and partial gasification of the oil. The mixed gas and vapour rush out under considerable pressure from a small aperture in the side of the far end of the tube down what is practically an inverted bunsen tube, through the holes in the side of which it draws in sufficient air to render the flame at the burner head not only non-luminous, but sufficiently oxidising in its character to prevent any deposition of carbon on the mantle. By the time the burner head is reached, the gas is practically down to atmospheric pressure again, so that the wear and tear to the mantle is not excessive.

The difficulties that were found with the forms of this lamp in use down to six months ago were the occasional clogging of the small vapour hole with carbon, and the risk that the oil might be turned on accidentally when the lamp was not in use. Another difficulty was that a defective valve might cause a slight leakage of oil through the vapour tube into the burner, which might, under certain circumstances, have resulted in the auxiliary flame turned on to heat the vapour tube causing a slight flare.

These objections have now, however, been surmounted, and the vapour tube is made with a needle holder and needle running longitudinally through it, so that the small vapour hole can be cleared in case of any stoppage by simply pulling a small chain attached to a lever arm working the needle, whilst any chance of oil escaping, either from a leaky valve, or turning on the oil supply to the cold lamp, is prevented by a thermostatic valve, which prevents any access of oil to the vapour tube until it is at a sufficient temperature to vaporise the oil properly. This valve operates by the difference in expansion of the two metals employed in its construction, and as long as the arm is cold it entirely cuts off the oil, and the valve being above the vapour tube, it cannot get hot enough to release the oil until the vapour tube has got to the proper temperature.

These modifications are a distinct improvement. Other steps in the right direction are heating the air supply before it enters the mixing tube, and so doing away with any danger of condensation of the oil vapour, and preventing a good deal of the hissing sound which was an objectionable feature of the older type.

It is satisfactory to find that the safety of the system is vouched for by the fact that among all the installations that have been put up in various parts of the world, no fire has originated from its use, and the progress during the past few years in new installations has been very satis-

factory. One of the great advantages which it has over the intensified systems of incandescent mantle lighting adopted to obtain big units of illumination, is that it does not necessarily disturb the streets, as the whole installation is self-contained.

Careful experiments that I have made with this lamp show, that with a large single burner, it is perfectly easy to obtain illuminating values of from 1,000 to over 1,200 candles; and that with large installations 1,000 candle power can readily be obtained for one penny, which is only one-third the cost of the same amount of light from the electric arc. The recent success of its adoption for the illumination of large open spaces in London and other cities, points to the fact that it is destined to play an important part in the street illumination of the future.

Air carburetted with the vapour of light petroleum yields an illuminating gas of considerable value, and several attempts have been made to utilise this for incandescent lighting. A successful form which gives an idea of the systems most in use is that devised by Mr. Van Vriesland, which is used in several places under the name of "Aerogene gas."

In this arrangement a revolving coil of pipes continually dips into petroleum spirit contained in a cylinder, and the air passed into the cylinder through the coil of pipes becomes highly carburetted by the time it reaches the outlet at the far end of the cylinder. The resulting gas when burnt in an ordinary burner gives a luminous flame, and can be burnt in atmospheric burners differing but little from those of the ordinary type. With an ordinary Welsbach C burner it gives a duty of about 30 candles per foot of gas consumed, the high illuminating power being due to the fact that the gas is under a pressure of from 6 to 8 inches.

A complete installation of this plant is to be found at the village of Breukelen in the Pays-bas, where it is used for street as well as for house lighting. There are about two miles of mains which in one place pass under a canal, and although one would expect in cold weather that there would be a serious deposition of the vapour, in practice this does not appear to be the case. It was found, however, that the evaporation of the carburetting material was much higher in the summer than in the winter, and this necessitated an adjustment of the air supply to the burners; when once this had been made, the lighting power of the installation was as high as before and worked in a perfectly satisfactory manner.

I made tests of the light given by the mantles close to the works and also at a distance of half a mile away, after the gas had passed below the canal, and found that there was a loss of only about 1 candle per cubic foot in illuminating power during distribution.

In considering the effect to be produced with the incandescent mantle by the combustion of gas in the atmospheric burner, we saw the great advantage of mixing the air with the gas before combustion at a point some distance from the burner head, and although this is of necessity done in using carburetted air, as in the Van Vriesland and kindred processes, yet a further extension of the principle gives greatly enhanced results, and gets over the difficulty which hampers all other processes due to over-carburation in hot weather.

In the Hooker process which I have examined in conjunction with Dr. Boverton Redwood, the air is only carburetted to the point at which it gives a non-luminous flame, that is, nearly the whole of the air needed for the combustion of the petroleum vapour is mixed with it before combustion, and this mixture is then consumed in burners of special construction, which eliminate any risk of flashing back, with the result that a great gain in illuminating value is obtained. This process promises results of the highest importance.

A very ingenious table lamp for burning petroleum vapour with the incandescent mantle has been devised by Mr. Legge, in which a reservoir filled with sponge or other absorbent material, is saturated with petroleum spirit containing volatile hydrocarbons in solution. The vapour from this, descending by gravity to the burner head, draws in the required volume of air for its non-luminous combustion, and gives a light of about 40 candles when used with a mantle, such a lamp having many points of convenience and value where coal gas is unattainable.

Yet another allied illuminant which has been steadily and quietly making headway during the past few years is acetylene, which, although the youngest member of the family of illuminants, is one that has already shown itself an important factor in illumination where coal gas cannot be obtained. I have so lately dealt with the subject in a previous course of Cantor lectures that there is no need now to go into details of its rise to favour, or the methods by which it is produced from the electrically-born calcium carbide. Although much hampered in its progress by the determined booming of improper forms of apparatus

that gave rise to much trouble and waste, it has gone forward without a check, and improvements have been made in all directions.

There are several generators now on the market, which leave little or nothing to be desired in their construction, as they are both simple and effective, and for country house lighting the beauty of the light has led to its firmly establishing itself as a favourite.

In the early days bad generators and smoking of the burners proved real difficulties, but the improvements in burners as well as generators have been of a marked character. Besides the well-known ones of Continental origin, Bray is now making some excellent burners, which show an improvement on the older forms, in that they can be turned down without any smoking. This will do away with the inconvenience which was inseparable from the older forms of burners, of either having to turn out the jet or leaving it to burn at its full size. The possibility of bye-passing the gas and so keeping the burner low when not required will undoubtedly prove a great incentive to the adoption of acetylene for the lighting of country railway stations, in place of the dim oil lamps now in use.

The improvements which have marked the last few years in connection with acetylene are largely due to the labours of the Home Office Committee on the Safety and Efficiency of Various Forms of Acetylene Generators, and also to the work of an excellent Acetylene Association, which has been formed to deal with all matters relating to calcium carbide and acetylene in the interests of the public and of the industry. The Association has already formulated regulations for the public guidance which have met with the approval of the Home Office authorities and also of scientific and practical men.

Like many new industries, carbide and acetylene have for a period suffered from over-confidence on the part of many of their earlier supporters, and on the Continent, where large water powers were available, factories were established one after another, as if it were only necessary to make unlimited quantities of carbide, in order to ensure a demand for it. The result of this was that, for a time there was considerable over-production, and capitalists and shareholders interested in carbide works suffered severely in pocket, as although the growth of the industry was wonderfully rapid, the supply was so great that stocks accumulated, and many factories had to close whilst others worked to a small extent only of their output. The industry has now recovered, however, from this plethora of material, and this year there has been a danger of going to the other extreme, and at the present moment something closely approaching to a carbide famine exists in some countries.

The price of carbide, however, has remained fairly constant, and even during the period when large stocks were being held it never fell to any very low figure, whilst so far the scarcity has not forced the price up to any great extent.

At the present time the annual consumption of carbide on the continent for railway, domestic, and village lighting is probably not less than 40,000 to 50,000 tons, whilst in the United States and Canada the yearly consumption is not less than 20,000 tons, and fresh works are being erected to provide for the rapidly increasing demand. The colonies are being fed with carbide, both from the European factories and from America.

In Prussia, something like 6,000 tons are used annually in the railways, which almost entirely employ a mixture of 25 per cent. acetylene with 75 per cent. oil gas for lighting railway carriages, such a mixture giving a remarkably fine illumination; but in England this system has not yet received a fair trial, as although the Home Office has sanctioned the use of such a mixture, the railway authorities have not yet done more than experiment with it in a very haphazard and unsatisfactory manner.

For the illumination of railway carriages, trams, and omnibuses, there is no doubt that acetylene has an enormous field before it. For some months the public in London were educated in the lighting power of acetylene as applied to omnibuses. Although owing to the faulty form of generators employed besides ample illumination, they also emitted an occasional whiff of highly characteristic scent, at the same time it was realised that the ability to read the halfpenny press with ease and comfort gave them a distinct advantage over the oil lamp which had previously made the darkness visible.

Unfortunately there were difficulties in details which prevented this from proving economically successful. In the first place acetylene generators in which the supply of water to carbide is so regulated as to give the volume of gas required to feed the burner in moving vehicles is under considerable disadvantages, owing to the jerking and jolting which upsets the arrangements for bringing

the water uniformly to the carbide, whilst the lamps being lighted at irregular hours and used for uncertain lengths of time caused another difficulty to be surmounted. A charge of carbide sufficient for the maximum possible supply must always be put in the apparatus, and if at the end of the day carbide still remains undecomposed, there is no help for it but to remove it with the sludge, and to replace it by a fresh charge. Moreover, a large amount of labour is entailed in cleaning and charging, whilst there are very grave difficulties in dealing with the large quantities of lime residue in a big city like London.

These troubles, however, are now in a fair way to be satisfactorily overcome by the introduction of acetylene dissolved under pressure in acetone, the solvent itself being absorbed by porous materials with which the cylinder is filled. The early researches upon compressed and liquefied acetylene show that it could be exploded under circumstances which made it inadvisable that it should be freely employed, whilst solutions of acetylene under pressure in acetone, although less liable to explosion, still could not be said to be sufficiently free from danger for general use. It has been discovered, however, by MM. Janet and Fouche that when the acetylene is dissolved in acetone absorbed by porous materials of the right kind under ten atmospheres pressure, it is impossible to produce explosion, even when electric sparks are passed through the containing cylinder, or platinum wires are fused in it. Exhaustive tests which I have seen carried out in France demonstrate the absolute safety of acetylene compressed under these conditions, and these experiments have been corroborated both in Germany and England.

Under this new system acetylene is evolved from carbide in the ordinary way, and after proper purification is compressed under ten atmospheres into cylinders containing a porous medium of 80 per cent. porosity soaked with 43 per cent. of the capacity of the tube with acetone, and in this way one cubic foot of cylinder space is found to hold 100 cubic feet of acetylene, which is again to a large extent given off when the pressure is reduced by opening the stopcock of the cylinder.

Supplied to burners through proper regulating apparatus this gives a magnificent illumination, and such cylinders of small size, fitted to trams and omnibuses, are perfectly controlled by simply turning a cock, so that all waste of gas, trouble with residue and smell are obviated. As the system is now in the hands of the Acetylene Illuminating Company in London, who have done such good work in all branches of the acetylene industry, and as the Home Office sanctioned its use in this form, it may be expected that public opinion and competition with the tubes will in the near future lead to the abolition of the old petroleum lamps, and the installation in its place of the more brilliant illuminant, especially as the difference in cost between the two amounts only to a few pence per week. For railway lighting the same method can be adopted with large tanks of the same character as those now used for compressed oil gas, but filled with the right form of briquette.

From the earliest introduction of acetylene attempts have been made to utilise it with incandescent mantles, but under the pressures which are usually obtained from the ordinary generating apparatus, this has been a practical impossibility. Although burners have been devised which for a short time gave a magnificent light with the incandescent mantle, it was very troublesome to prevent the flashing back in the burner tube with considerable explosive violence, an action which blew the mantle to pieces. With acetylene under pressure in acetone, however, any desired pressure at the burner can be obtained, and with a pressure of eight inches and upwards an acetylene burner can be made to work perfectly well with a mantle, the maximum illuminating power being given at a pressure of ten inches, when a light of 146 candles per cubic foot of acetylene consumed can be obtained. If the pressures rises above this point, although the total candle power is increased, the duty of the mantle falls. The results I have obtained are shown in the following Table:—

ACETYLENE WITH INCANDESCENT MANTLES.

Pressure. Inches.	Consumption per hour, cubic feet.	Light. Candles.	Candles per cubic foot.
8	·883	65	73·6
9	·94	72	76·0
10	1·00	146	146·0
12	1·06	150	141·2
15	1·25	150	120·0
20	1·33	166	124·8
25	1·5	186	123·3
40	2·12	257	121·2

Another use to which the high pressure acetylene in acetone can be put gives promise of considerable commercial value, and depends upon the great calorific intensity which can be obtained from a flame of acetylene fed with

oxygen. Many attempts have been made to utilise acetylene in this way, but the intense heat has always resulted in the choking of the burner by carbon liberated in the form of graphite from the acetylene, which gradually closes up the jet in any ordinary oxyhydrogen blowpipe.

A new burner, however, has now been devised which is so constructed that this trouble is surmounted, and a flame of enormous calorific intensity is produced, which is far greater than that obtained from the oxyhydrogen blowpipe; whilst, owing to the high temperature which exists in the flame, and which is well above the dissociation point of water, sufficient hydrogen is present to render the flame highly reducing. It can, for this reason, be utilised for the autogenous welding of iron plates, and also for the cutting out of the damaged portions of a plate, by fusing a series of holes round the damaged part, and then cutting out, so that it seems probable that with a little advance in the method of using, it may be possible to cut out the damaged portions of boiler and other plates, and to fuse in pieces of similar metal autogenously, which would undoubtedly be an enormous advantage.

I regret that I have now used up the time placed at my disposal, and also that the review of my subject that I have been able to give has of necessity been so imperfect. In conclusion, I should like to tender my thanks to my assistants, who have been indefatigable in carrying out the experimental work brought before you, and to those gentlemen who have helped me by the loan of the exhibits we have had to-night, whilst last, but not least, I must thank you all most heartily for the sympathetic attention you have given me.

SIXTH ORDINARY MEETING.

Wednesday, January 14, 1903; SIR ROBERT GIFFEN, K.C.B., LL.D., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Barnes, Warren D., care of H. S. King and Co., 45, Pall-mall, S.W.
Berrington, Evelyn D., The Ayrshire Mine, Lomagunda, Mashonaland, South Africa.
Bharoocha, Sohrab Framjee, Shamjee - building, Sleater-road, Bombay.
Bradshaw, Vincent Edward Patrick, Resident Magistrate, Taung, Bechuanaland, South Africa.
Cowasji, Hormusji, Aden.
Cobban, Alexander McDonald, Scunthorpe Urban District Council, Scunthorpe, Doncaster.
Crichton, Lionel A., 18, Hamilton-terrace, N.W.
Damon, Samuel Mills, Honolulu, Hawaii.
Dawson, John Eugène, Freetown, Sierra Leone, West Africa.
Eames, James Bromley, M.A., B.C.L., 1, King's-bench-walk, Temple, E.C.
Evered, John E., 99, Cannon-street, E.C.
Gibbs, Hon. Alban, G. H., M.P., 82, Portland-place, W.
Higgs, Arthur W., 34, Minard-road, Catford, S.E.
Irani, Burjoe Sorabshaw, Gowalia Tank-road, Cumballa-hill, Bombay.
Johnston, William, 18, Water-street, Liverpool.
McClintock, Captain Frederick William, P.O. Box 71, Krugersdorp, Transvaal, South Africa.
Maclean, Kaid Sir Harry Aubrey de Vere, K.C.M.G., The Court, Morocco.
Magill, Arthur Edward, United States Patent-office, Chemistry Department, Washington, D.C., U.S.A.
Magill, Dr. William Seagrove, Carnegie Laboratory, 26th Street, and 1st Avenue, New York, U.S.A.
Noyce, W. F., K.I.H., Extra Assistant Commissioner of the Burma Provincial Civil Service, Rangoon.
Onslow, Earl of, G.C.M.G., 7, Richmond-terrace, Whitehall, S.W.
Rao, D. Gopal, The Castle, Tholasinga Peruma, Coil-street, Triplicane, Madras, India.
Robertson, Peter, Bohemian Club, San Francisco, California, U.S.A.
Schafer, Frederick William, Lynne-court, Park-hill-road, Croydon.
Sharples, Stephen Paschall, 26, Broad-street, Boston, Massachusetts, U.S.A.
Spencer, Norman, Assam Bengal Railway, Suffrai, P.O. Assam.
Swift, James Beaumont, 54, Gracechurch-street, E.C.
Taraporvalla, Viccajee Ardeshir, Girgaum, Back-road, Bombay.
Taylor, James Edward, 71, Ravensdale-road, Stamford-hill, N.
Todd, Prof. David P., Observatory-house, Amherst, Massachusetts, U.S.A.
Wigglesworth, Frederick, M.A., Weymouth-park, Walton-on-Thames.
Wigglesworth, Herbert Hardy, F.R.I.B.A., Gwydir-chambers, 104, High Holborn, W.C.
Woodward, Robert, Oakholme, Worksop.

The following candidates were balloted for and duly elected members of the Society:—

Acland, Miss Sarah Angelina, Cleveden-house, Park-town, Oxford.
Dallin, Cyrus Edwin, 89, Oakland-avenue, Arlington Heights, Massachusetts, U.S.A.
Dangerfield, James, Artillery-mansions, Westminster, S.W.
Dunham, Andrew Allen, care of Casein Company of America, 11, Broadway, New York, U.S.A.

Dunnicliff, H. B., 5, Kestrel-avenue, Herne-hill, S.E.
Gibson, James Glen S., F.R.I.B.A., 27A, Old Bond-street, W.
Giddons, John Harcourt, Austral, near Liverpool, New South Wales, Australia.
Hopkins, John Guthrie, Alberene, Albermarle County, Virginia, U.S.A.
Judd, Walter, 5, Queen Victoria-street, E.C.
Kinealy, John Henry, 1108, Pemberton-building, Boston, Massachusetts, U.S.A.
Livesey, David Thomas, Luxville, London-road, East Grinstead.
McCormack, Joseph Nathaniel, M.D., LL.D., Bowling-green, Kentucky, U.S.A.
McLusky, William B., City of Perth Gas Department, Perth, N.B.
Scantlebury, Captain Vincent John, Assoc.Inst.N.A., 21, St. Petersburgh-place, Bayswater, W.
Scott, Percy Gilbert, 34-37, Dobson's-road, Howrah, India.
Silberrad, Dr. Oswald, Hill-top, Shooter's-hill, Kent.
Spencer, Frank Barnes, Ovenden, Kingswood-road, Wimbledon, S.W.
Wall, J. W. Russell, Raglan Villa, Holly-park, New Southgate, N.
West, George F. Myddleton Cornwallis, J.P., 35A, Great Cumberland-place, W.
West, Mrs. George Cornwallis, 35A, Great Cumberland-place, W.
Woollan, Miss Helen A., 28, Brook-street, Grosvenor-square, W.

The paper read was—

INDUSTRIAL TRUSTS.

By Prof. W. Smart, LL.D.

The subject is a large one to cover in an hour, and I shall not waste time, either by introduction or by dwelling on matters of common knowledge.

The two sides of the phenomena we have agreed to call Trusts—the good and the bad—are summed up in two words, Economy and Monopoly.

First, of Economy. Ever since Adam Smith we have been familiar with the economies of large production. But a Trust is more than a large producing unit. It is an amalgamation of organisations which have separately exhausted the economies of large production possible to them, and which find a new saving in organising these separate organisations. Thus the possible economies are very great. They are, briefly, four.

(1). The usual economies of production on the very largest scale—economy in manufacture, in buying, in selling, in office work, in warehousing, in freighting, in financing; and, besides, the utilisation of many bye-products which would be wasted in smaller scale production.

(2). The saving of the waste involved in keeping up, pushing, and advertising separate and rival businesses; every amalgamation at once reduces a crowd of *employés* to the position of mere middlemen—as for instance, the 300 travellers dispensed with by the Whiskey Trust.

(3). The competitive bookkeeping — the check and stimulus involved in comparisons between the working of businesses which have hitherto been worked on various principles, but will, sooner or later, be worked only on the ascertained best.

(4). The possibility of extreme specialisation—separate mills or plants being set aside to do certain things exclusively.

Consider for a moment only one of these economies. What is the gain of advertisement—the gain to the community apart from the gain to the advertiser? There may be such a gain on the introduction of a commodity, when new utilities are to be brought to public notice. But, apart from this, it seems to be the case that what one seller gains by advertising, another loses, the community buying no more. Advertising, I mean to say, will perhaps induce me to buy Pears' soap instead of Vinolia soap, but it will scarcely induce me to buy more soap. If this is the case, we must say that enormous sums are spent by producers purely in a struggle to take away trade from each other, without adding anything to the total product of the community's industry,

Here, then, if anywhere is the defence of the Trust. It is a long step towards the maximising of product and the minimising of effort, which is said to be the goal of economic progress. If we could be sure that these huge economies fell into the proper hands—say a perfectly upright and perfectly capable municipality giving these economies to the people in the shape of cost prices—there would be little to be said against the idea of the Trust.

At the same time, it should not be overlooked, or dismissed as not worth consideration, that such economies have a debit side. Works cannot be shut down, workers turned off, employers crushed or bought out, acquired skill made useless, without much individual suffering, and there will be this suffering into whatever hands the economies fall. And there

is, no doubt, a certain loss involved in the elimination of the independent producer. There are some things in independence which are worth preserving for themselves; the struggle of the small man upwards makes for character, resource, and initiative. But, as a fact, this argument has practically got its death blow from the working classes themselves; the greatest foe of the small producer is the co-operative society.

So far, then, as this side goes, Trusts are phenomena of economic progress. They are the elimination of the unnecessary person, the unnecessary process, and the unnecessary thing in the production and distribution of goods.

Second, of Monopoly. By natural evolution such great economic organisations tend to become, and often actually are, private monopolies. Now monopolies have three very dangerous powers; over price, over improvements, over labour.

I. *The Power over Price.*—In virtue of the great economies just mentioned, Trusts should result in low prices. But when the economies fall into single and powerful hands, this by no means follows. It may be said generally that monopolists will charge as high prices as they can economically demand.

There are, of course, very serious limits to this power. There is the fact (1) that demand generally falls off as prices rise; (2) that no monopoly is absolute; the higher the price is driven, the more tempting the inducement to break in on it; (3) that what the monopolist aims at is high profits, and that equally high profits may be made—and more safely made—from a large output at low prices as from a restricted output at high prices; and (4) there is the presence of substitutes for the monopolised goods—as science grows, the field of supply for any human want widens.

To this may be added a fifth limit—the desirability of conciliating public opinion. The morning after the announcement of the Harvesters' Trust, Mr. Morgan declared that its first step would be a 10 per cent. reduction in the price of agricultural implements, adding significantly, "the companies could stand a further reduction in the export trade."

As a result of these limits, we do not, as a rule, find that, when a product becomes monopolised, its price is raised, unless where heavy cutting has attended the formation of the monopoly—and one is apt to forget that, with all these economies, the price might have been expected very greatly to fall.

On the other hand, there is a special feature in modern monopolies which seems to make for high prices. It is that a new element of cost is added by the capitalisation. In the formation of a monopolist amalgamation, plants are not valued so much by their producing power as by the necessity of taking in as many businesses as possible. Stock accordingly is issued against concerns bought at a ridiculously high valuation; the stock gets into the hands of the public, and dividends are demanded on the whole of the issued capital. If the monopoly is effective, the demand is met, and the dividends got by raising prices. It is the same where large amounts of stock are given to promoters and underwriters. Moreover, by watering stock in this fashion the public is quite misled, and easily swallows the contention that prices cannot be unduly high, seeing that so much of the stock is paying no dividend.

II. *The Power over Improvements.*—The monopolist whose position is secured will not make the same experiments or run the same risks as competitive industry would. Monopoly takes away the chief stimulus to improvement of organisation and process, the fear of being undersold by the new comer, the person who, presumably, has the latest appliances for reducing cost. And what the monopolist will not do himself, he will prevent others doing. Where he has a wide and varied market, he can crush the new comer, not by the power of working more economically, but by concentrating his attack on a few points.

III. *The Power over Labour.*—This must necessarily be very great. Where a dozen employers are rolled into one, monopoly means restriction of the competition for labour which would otherwise exist among employers, and throws the advantage in the wage bargaining heavily against the worker. It need not be assumed that the advantage will be exerted to the utmost. Enlightened monopolists, like other employers, know that highly paid labour is cheap labour, and, with all the economies of combination there should be ample room for rising wages. And neither Trusts nor Combines seem markedly hostile to Trades Unions. But the power is there.

These are the three dangerous powers which monopoly possesses. It by no means follows that the persons in whose hands the monopoly is will use these powers badly. Monopoly is a private interest, but private interest need not be incompatible with a large measure of public interest; may, indeed, be the same as the public interest. And, further, although the

monopolist may make his fortune by attending to his private interest, he may spend it entirely in the public interest—or what he conceives to be so. But, human nature being what it is, it will be generally agreed that such powers are too great to leave unreservedly in private hands.

And for this reason there seems to me one conclusion to be drawn, although I state it with some hesitation. It is that, if we are convinced that such huge organisations, with their inevitable tendency to monopoly, are the forms which industry is going to assume in the future, it might be advisable, where we can, to secure that industries which, by their nature, must be monopolies in any case, should be taken over by municipalities before they grow too large and too dear to be taken over. If the danger to progress, and danger to labour can be thus avoided, and if the profits, which would otherwise fall to monopolists, can be used to reduce the prices of goods, it seems legitimate argument for municipalisation.

The problem, then, which all countries have to face is how to preserve the economies of these great organisations, while preventing the evils which arise from monopoly.

To pass now from general theory, and consider the present situation in the light of it. On both sides of the Atlantic, of late years, we have the emergence of what seems a similar phenomenon, the amalgamation of a great many businesses into one. In America, curiously enough, these bodies are called by the fine Saxon term, Trust; with us, they are known by the eminently American term, Combine. Are they really the same phenomenon? I think I shall be able to show that, while presenting many features of resemblance, they are different in origin, different in many respects in constitution, and different in issue.

The features of resemblance are these:—

(1). They are both very large, as regards the capital and as regards the businesses combining. The Democratic Congressional Committee has issued a list of 287 Trusts, with a total capital of seven milliards of dollars (£1,400,000,000); and this list does not include combinations based on price and rate-fixing agreements, profit-sharing pools, buying and selling arrangements, nor does it include what are pleasantly known as "friendly agreements among gentlemen," such as the so-called Beef Trust—the "Big Four." The Harvesters' Company has a capitalisation of £24,000,000, the Amalgamated Copper Company of £31,000,000, the Imperial Tobacco Company of £52,000,000, and the United States Steel Corporation of no less than £280,000,000. We, on this side, have the United Alkali Company and the Calico Printers, each with over eight millions of capital, embracing respectively 51 and 47 firms; the Bleachers Association, the Fine Spinners, the Portland Cement Manufacturers, each with over six millions of capital, and embracing respectively 53, 47, and 30 firms. We have the Wallpaper Manufacturers with over four millions of capital, turning out 98 per cent. of the total product of wallpapers, and so on. Besides these, we have the international thread combines, in which three separate but allied organisations produce, I think I may say, practically the whole of the cotton thread used in the British Empire and in the United States.

(2). The movement in both countries is of very recent date. I have beside me a list of 82 Trusts, with a total capital of 4,328,000,000 dollars (£865,600,000), formed within the last three and a-half years. The most of our Combines came out between 1898 and 1899.

(3). The form of organisation is very much the same in both countries. The name "Trust" is, of course, a misnomer; the kind of organisation where a number of businesses transferred themselves to a body of trustees, getting in exchange "Trust certificates," is illegal since 1890, and the prevailing form of Trust now is the same as that of our Combines—one large single company which has acquired outright all the different plants, patents, and goodwills.

The differences, however, are very great.

I. *As Regards Origin.*—The difference cannot be put better than in Mr. Crewdson's words:—"The Trust was designed primarily as a weapon of war, aggression and attack. The Amalgamation is primarily a measure of self-defence and peace." The history of most of our amalgamations may, I think, be summarised thus:—First, a long period during which the firms work alongside each other in a good-natured old-fashioned way—competing, indeed, but not "poaching," as it would have been called once upon a day. Then the intrusion of new comers, who are not content to make a trade for themselves by taking up new demand, but wish to carve a kingdom out of other people's territories, and take the short way of cutting prices. If the old firms do not follow, they lose trade: if they follow, they lose money. Suppose they follow, and the new comers go lower still, this will

cure itself no doubt in time, but it may be a very long time. For it is more than likely that the new comers have put up their mills more cheaply and have got together a more economic organisation, and it is by no means certain which will go to the wall. In any case, it will be a long time before this is decided: once the new factories are built and started, there is no discharge in this war. To stop, means losing everything—or nearly everything—but scrap value; and it means even worse to the old firms, whose owners are, in all probability, fitted to do nothing else, and live on their capital till the capital has disappeared. The truth of this is written in hundreds of old mills one comes across in the country, working alongside new mills, with which they cannot possibly compete on equal terms. It is only in text-books that losing firms close down and relieve the competition. So one of the firms, perhaps, getting tired of the long prospect of non-paying years, proposes an agreement. By this each gives up the hope of seeing all but itself disappear, but each gains security and profits. The first step is a common price-list and common terms; and this first step is taken by many industries which never go further along the way that ends in a Combine. It may or may not be accompanied by differential limitation or proportioning of output over the firms.

But this common price-list of itself points to a further step. It brings to light many forms of waste involved in keeping up separate organisations, and suggests how these might be got rid of. In other directions, the common price-list causes new expenditure; for, in this case, the only thing that can sell goods—cutting being ended—is advertising. Any hundred a year "commercial" can sell goods if he is allowed to offer better prices or terms, but it takes a highly-paid man to sell when he can give no such monetary inducement.

While economy thus suggests a further step, the known impossibility of working a common price-list agreement without endless quarrels emphasises it. I do not say that where three people come to an agreement, one at least will be thinking all the time of how to get round it or break it without being found out. But I do say that, of the three, two will suspect at least one, and will not always waste time in proving whether he is guilty or not, but will make reprisals. And I will say further, that the most honest gentleman cannot, do what he will, control the actions of dozens or scores of agents and travellers. And so the history of all common price-list agreements—I should say without exception—is that they are constantly being broken, patched up, and broken again.

From the common price list then, to the central selling agency—an agency which sends out travellers and employs agents to sell three or four brands, does all the office work under one roof, and by one organisation, and where underselling is made almost impossible—is an obvious step dictated by economy; and, from the selling agency to the closer union known as the Combine, is really a much shorter step.

In the above I am sketching from life—from the annals of a trade I know; but I have no doubt that very much the same history led up to all our Combines. The negative cause was cut-throat competition; the positive, the possibility of large economies.

According to Mr. Havemeyer, the origin of the American Trust is the same. The high tariff, he says, making the protected industry very profitable, tempts much capital into it. Plants are carelessly put down in unfavourable locations, and unqualified men become employers. The pressure of home competition becomes very severe, and the only safety is combination. This is what he meant by the often quoted dictum—usually misunderstood—that "the mother of all Trusts is the customs tariff law." It is a curious commentary on the accepted theory that Protection means the restriction but not the annihilation of competition; that it aims only at putting the home producer on an equality with the foreign producer who sends in goods made at a lower cost. On Mr. Havemeyer's reading, Protection appears as leading straight to the disappearance of foreign competition; to congestion of capital in the home market; and to internal competition so severe that the home producers themselves require a second protection—protection from each other!

But whatever we may think of his reading, we need have no difficulty in accepting the statement that excessive competition, and the evident economies of large production, are the economic bases of the Trust. But there is this difference; that the Trust has been very greatly the work of the promoter and financier. Manufacturers have been tempted into Trusts by extravagant prices offered them by outsiders. This is reflected in their notorious capitalisation. The principle of at least many of the capitalisations, seems to be that every £100 of real value of assets is

capitalised at £100 of bonds or preferred stock, plus another £100 of ordinary stock. If the bonds or preferred stock are kept at par, and pay their dividend, the vendors are fully paid; and although the ordinary stock may never pay a penny, there is always the chance of selling it for something. As to promoters' profits on the transaction, they are usually estimated at 20 to 40 per cent. of the capital stock issued. Here, of course, is stock manufactured, like the famous razors, to sell. Those who get it have no interest in the welfare of the business—only in the success of the promotion. There is one case often quoted—that of the Standard Distilling and Distributing Company—where each plant valued at 100,000 dollars had to earn a dividend on 600,000 dollars!

It may be safely said that our English combines stand comparison with this. The worst that can be said of any of them is that they embrace many rotten members, for which a large price was paid; but this price was not paid to water the stock for selling purposes. Nor has the capitalisation been increased to any scandalous extent by payments to promoters. The concerns combined were not, indeed, of such a doubtful character that they needed strong promoting and financing. At the time when so many were formed, it was considered a favour to get an allotment; and, as Mr. Crewdson has said, there was no need for underwriting. The capital not taken up by the public was taken up by the vendors; and, as a fact, there was much grumbling at the Stock Exchange limit, which prevents vendors taking more than one-third the purchase price in stock.

In a word, our Combines are a last stage in the evolution of the system which Adam Smith called "Natural Liberty." I hold that they are as "natural" as the system itself. As the world grows wealthier, competition grows keener—for the reason that production always tends to out-run consumption—and cut-throat competition suggests its own remedy of combination. And the combination saves us from something worse, the monopoly of the survivor. Trusts, on the other hand, are the somewhat artificial evolution of the essentially artificial system called Protection.

II. *As Regards Issue.*—Both forms of organisation, indeed, aim at being monopolies. The difference is that while, thanks to Protection, the Trusts, secured against competition from outside, may attain effective monopoly within their own country, and enjoy the high prices of monopoly, our Combines, as living under the fierce struggle of competition with all the world, can survive only at the cost of eternal vigilance, efficiency, and low cost. Neither the actual nor the possible competitor are likely to perish out of the land in a free trade country. And it may be noted that there is this further difference in issue, that our Combines have not, as a rule, been strikingly successful. Hence we see, meantime at least, a distinct check to the formation of further Combines. Will anyone say that, suppose a new Combine were floated to-morrow, there would be a rush to obtain shares, such as there undoubtedly was three years ago? But in America there has been no such check.

III. *As Regards Constitution.*—Thanks to our strict Companies' Acts, our Combines are carried on under the public eye. The balance sheets and annual meetings get into the public prints. The rights of shareholders are defined and exercised. The powers of directors are strictly limited. But in America one has the extraordinary spectacle of a competition between States which shall give the most elastic articles of incorporation and the cheapest, not only as regards charter fees, but as regards taxation. New Jersey, for instance, gives a charter for any lawful business or purpose whatever, demands no limitation of the capital stock, does not exact annual meetings, and allows directors to apply surplus earnings to the purchase of property—including their own capital stock—"from time to time, to such extent, and upon such terms as the board of directors shall determine." But West Virginia is overbidding her. Here the fee is only 56 dollars, and the annual tax 50 dollars. No director need be resident in the State; annual and other meetings may be held outside the State.

As a consequence, it is said, no one buying the stock of a Trust company knows what he is buying—either what has been paid to vendors, promoters, and underwriters, or what assets these payments represent; the powers given to directors, officers, and shareholders respectively are not defined in the certificate of incorporation; detailed and audited accounts are not published yearly; no information is obtainable as to the methods and conduct of the business.

Thinking over these three differences of origin, of constitution, and of issue, it has seemed to me that there is a peculiar difference between American conditions and ours which underlies and partly explains the other three.

It is the appearance in America of a new class, that of the business millionaire—a phenomenon so new that we have scarcely appreciated or studied it sufficiently.

It has been said that some 87 per cent. of the millionaires in America have built up their fortunes from the very bottom. That is to say: they are not men of leisure and culture, administrators and statesmen, not even landowners, but restless, energetic, tireless men, whose thoughts are concentrated up till old age on one thing, business.

Now if these men are magnates in many Trusts, and the Trusts work into each others hands; if they control, to a great extent, the railways, while the railways themselves own coal and mineral and oil lands, and can exert the immense influence of differential railway rating: if such men exert, as they necessarily do, great political influence both on legislation and administration; and if industry generally is carried on under the highly artificial system of Protection, I think little more need be said to prove that the Trust becomes something essentially different from the Combine both in its conduct and its issues.

If the differences then between Trusts and Combines are so great, it is not illogical to conclude that the treatment must be different; or that, at any rate, if "something must be done" in the one case, it by no means follows that anything should be done in the other.

Public opinion in America seems thoroughly roused against the Trusts. The President himself is reported to have said that "these enormous monopolies whose actions result in evil, must be broken," although, it must be confessed, he does not seem very clear, either as to the nature of their offending, or as to the remedies. This feeling has taken the direction of Anti-Trust legislation. Twenty-seven states and territories make Trusts punishable by fine and imprisonment, and there is, besides, the Federal Anti-Trust Law of 1891, to the passing of which, it may be noted, Tammany gave its support. But, hitherto, all such legislation has been utterly futile. If you study the wording of these Acts, with their emphasis and dependence on such loose phrases as "restraint of trade," and "attempt to monopolise," you will understand why they have failed, and agree, I think, that they deserved to fail.

Conscious of this, politicians and economists are directing their thoughts, not to legislation against Trusts, but to legislation against certain acts usually associated with Trusts, such as cutting prices below cost with intention to crush, contracts of exclusive dealing, and the like.

I must say that I cannot understand legislation on such lines. No business man would say that such acts have come into existence with Trusts; they are the commonest phenomena of all keenly contested business. Instead of being anti-trust legislation, this would be legislation against ordinary incidents of competition. Where convictions would turn on such questions as whether a Trust was selling above, at, or under cost—particularly when it was the cost of one single article out of a whole price list; whether there was "intention" to crush as distinct from legitimate retaliation or business policy to meet a new demand, &c., legislation is not so much hopeless as ridiculous.

There is another proposal much canvassed; it seems likely to be adopted as a political "plank" by the Democrats, and has met with some support from economists. It is to withdraw the protection of the tariff from industries which have passed under the control of Trusts, and let them meet foreign competition. The objection is obvious enough; that, if such drastic measures were taken against Trusts, the first to go under would be, not the Trusts, but the competitors and rivals that still survive. Even economists who have no love of Protection shrink from its sudden and violent withdrawal. Meanwhile, the President seems to have given a new lease of occupation to the Trusts in announcing that he means no interference with the tariff.

There are certain measures, however, which cannot be called anti-trust legislation, and yet would go far to prevent the chief evils of Trusts.

One is strict legislation, uniform over the States, as regards the promotion, constitution, and subsequent conduct of public companies. Without claiming finality for our legislation, we may point to our Companies Acts, and particularly the Amendment Act of 1900, as an example which might very well be followed by the United States.

The other is legislation which would be effectual in stopping preferential railway rating—an abuse to which many attribute the success of the trusts. It will be remembered that our Railway and Canal Traffic Act of 1854 forbids any company to "make or give any undue or unreasonable preference or advantage to or in favour of any particular person or company, or any particular description of traffic in any respect whatsoever." Under this law, favouring discrimination is

practically unknown. In the absence of legal prohibition, it is quite clear that competing railways will cut freight charges to secure the custom of a monopoly, and, where members of the monopoly control the railways, they are pretty certain to make use of one group of shareholders to further the interests of another. The evil is intensified where the railways are themselves owners of monopolies. There they make their freights conform to the policy of the moment as regards the goods carried. If, *e.g.*, they are cutting the price of coal, they carry their own coal for nothing, and raise freight against competing coal. The discrimination in oil freights is, of course, a matter of history.

These abuses have not been allowed to go on without a vigorous attempt to check them; and it is a fact that, since the passing of the Inter-State Commerce Law in 1887, discrimination in freights is illegal. All the same, the law is everywhere said to be inoperative. It "cannot be enforced," said the Inter-State Report, January, 1899. "Under the present law, discrimination is inevitable," said the Inter-State Commerce Commission in 1900.

Now it seems to me that merely to state the failure of American legislation, in face of the confessed evils of Trusts, is enough to suggest that legislation against our Combines, where similar evils have not emerged, is quite uncalled for, and would certainly be equally futile. As I have said, amalgamations are perfectly natural, meaning, by that much abused word, "what might have been expected." Competition after all ends in selection. Excessive competition could end only in the survival of the strongest—that is, in monopoly—if it did not end in combination. Unless we are prepared to legislate against competition, I cannot see that we could legislate against combination. In a word: where legislation is hopeful and possible in America, we do not need it; where it has been futile, it is directed against evils which do not exist here.

But, indeed, our anxiety about Combines is surely a little uncalled for. The further division of labour is inevitable. This means further specialisation. Now specialisation is taking two directions. One is the Combine, making certain staple goods in large quantities. Here, indeed, the small producer drops out. But the cheap standard goods made in this way form a new cheap raw material for other industries, which specialise on these as foundation. For instance, I have a friend whose business is the making of delicate electrical apparatus. When he wants standard machine tools he gets them, for the most part, from America. But when he wants special tools made to specification, he goes to France or Germany, who are able to supply them cheaply, because they, in turn, get the component parts from America. In short, on this large standard production of the Combine or Trust are being built up all sorts of special industries which are for ever free from being swamped by the Combine.

Again, those who think of the Combine as crushing out independent producers forget, I think, that it is only certain industries which can pass into Combines. Wherever a man stamps his individuality upon his work, the Combine is impossible. This, again, points to another division of labour which is going on under our eyes. The large routine industries, employing machinery and comparatively unskilled labour, are bound to pass into larger and larger units, because the fixed charges decrease as the output increases. But this same division of labour is throwing those who use their brains into a class by themselves. The enormous spread of journalism illustrates what I mean. The printing of the literature falls to great combinations; so does the making of the machinery. But the author works by himself. The fact just is that the spread of education is tending to throw men and women into occupations where machinery cannot touch them. Miss Collet it was, I think, who reminded us that the largest single industry in the United Kingdom is that called domestic service. As wealth and culture grow, the increasing demand is, not for more cakes and ale, but for the things which have been, ungracefully but graphically, described as "mind products"—the immaterial services which can be rendered to society only by men and women themselves. Here the principal factor of production is not machinery, but human brains. In this class of commodities, large production has no advantage, and neither Trusts nor Combines affect it.

But I feel bound to say that our interest in the subject does not end with academic comparisons, and with the conclusion that, as the Combine is a phenomenon of economic progress, and is free from at least the greater evils of the Trusts, we should and probably could do nothing to check it. It seems to me, on the contrary, that we are very much interested in the American Trust, though in a way that has not yet got due recognition.

It is very often assumed as self-evident that

a protective tariff favours the formation of Trusts. I do not challenge the fact but I am inclined to challenge the assumption. How does it do so? Why should the exclusion of foreign competition in whole or part have anything to do with Trusts? The question seems to me to admit of no answer on any lines I have laid down here. I said that the one root of Combines in this country was cut-throat competition. But, in America, if there is any virtue in Protection, competition is restricted. I said the other root of Combines was the possible economies. But what is the special motive to economy and low cost of production where a paternal Government takes the American manufacturer under its wing, and allows him to make profits rather by high prices than by low costs? And, if we are going to account for the Trust by the tariff, how are we going to account for Combines?

The fact is that here the word Monopoly misleads us. We confuse two quite different monopolies. It is said Protection leads to monopoly and Trusts are monopolies. True, but the monopoly which a protective tariff tends to give is only monopoly of its home market as against outsiders. But Trusts are monopolies inside this monopoly—monopolies of the few Americans against the whole body of Americans. Suppose you put a fence of a 60 per cent. tariff round any industry, you enable the industry to charge up to 60 per cent. higher prices; but how does this favour one protected producer more than another? That American manufacturers have a monopoly of their home industry against the Englishman is no reason that I can see why they should hasten to make themselves monopolists against each other.

Undertand that I am asking whether there is any special element in Protection, as distinct from Free Trade, that favours the formation of Trusts. I think there is. It seems to me that a tariff favours and induces Trusts in that it puts a special premium on large production.

Large production is, of course, cheap production, and for this reason, everybody wishes to be a large producer. What, then, prevents everyone rushing into production on the largest scale? It is, as everyone knows, the difficulty of selling an increased output without bringing down prices. If a man has a trade at ordinary paying prices, and begins to make more than he can sell at these prices, he dare not sell only the surplus at low prices. This would be a kind of revoke, calling down the wrath of his customers and spoiling his own market. So well is this understood that, in a common uniform price agreement, it is usually forbidden to sell even old stock at a reduction without taking off marks and labels and selling it as a job lot. In modern industry, we are understood to play the game. Our customers pay our list prices on the honourable understanding that they are getting the best prices and terms. They could not carry on business otherwise, for they live by selling the goods over again, and if one customer gets better prices, he cuts the feet from under the others. And this will not hide. There is nothing more damaging to an established trade than to break one's prices; the phrase "spoiling the market" really means spoiling one's own market. Thus, in ordinary cases, although he knows that enlarged production would mean lower cost, the manufacturer extends his business only as he finds demand increasing, and this is generally a gradual process.

But Protection gets over this difficulty. If, owing to a tariff, competition within a country is restricted, and prices accordingly are kept high, any surplus that cannot be sold profitably at home can be exported without spoiling the market. Thus the limit to large production is removed; overproduction at home is prevented; the fixed charges are attached to the goods sold at home, and exporting even at cost shows no loss. It will be remembered that, in 1901, the price of steel rails in the United States was approximately 29 dollars per ton, at a time when Mr. Schwab publicly announced his readiness to deliver steel rails in England at 16½ dollars.

Now this is nothing less than a subsidy paid by the American consumer to the foreign exporter. Just as the German manufacturer could not keep up his price for beet sugar at home to 5d., were it not that the Government enables him to sell his surplus here, in competition with cane, for 2d., so the American can extend his production, and yet keep up his prices at home, because he has an unlimited market abroad where he can get rid of any surplus at a low price.

It would not pay him, of course, if he were sending the bulk of his goods abroad. But if there is any truth in Mr. Carnegie's estimate, that the home market of America takes 96 per cent. of all its manufactured articles, the 4 per cent. may be given away without making much difference to a dividend. If it be thought that 4 per cent. is too small an outlet to relieve and prevent over-production, it should not be forgotten that the large production allows prices at home to be reduced, and so increases the sales.

Hence, I imagine, I notice a quite erroneous feeling about this action of American Trusts. It is assumed that the American maker is trying to crush us out with the view of getting an international monopoly for himself—just as Mr. Morgan is often credited with this extreme form of patriotism. The American manufacturer is doing nothing of the kind. It is the American market he wants. It is the high prices under Protection which he aims at getting and keeping, and the way he keeps them is by this outlet for any surplus that otherwise would spoil his own market. If one doubts this, let us ask if Mr. Schwab is repeating his offer to-day?

Compare this with our case. When our manufacturers have for the moment a surplus, they may, indeed, export it. But they have no paternal Government to protect them against the competition of other nations; they are daily fighting with the whole world, and their prices accordingly are keenly competitive prices. Below that level they cannot go, and, if they export below those prices, it will be at a loss.

This, then, to my mind is the special connection between tariffs and Trusts which we were seeking. Large production is the connecting link.

If I am right, it will be seen that we have a double problem as regards the great combinations. Our own Combines—their power over price, over improvements, over labour—form one problem. The other problem is this new development; the American Trust entering our own markets and neutral markets, under the encouragement of a bounty—and not a bounty on one article, but a bounty on all articles made by Trusts and exported. This explains why American exports are not exports of one or two great articles, or of raw produce only, but a long list of small exports very much like our own. And if I am not mistaken we are more interested in the latter problem than in the former.

All the same there seems to me no reason for any pessimistic outlook. Industry, indeed, never goes back. America has set the pace in large production, and, if we are to keep our place among exporting nations, we must reconstruct many of our industries on a similarly large scale. So far as I can read the signs of the times, our manufacturers have realized this necessity. Outside of the great Combines —and more quietly and successfully—they have been enlarging the unit of production in another way, namely, by the amalgamation of successive and related processes and industries, securing similar economies to those of the Combines without the weakness, incidental to the formation of a monopoly, of taking in doubtful members. And, in the international race, our manufacturers are free from the heavy handicap which Protection puts on export trade.

If this is the case, the "American Invasion," as it has been called, is only a blessing in disguise. I do not think, for instance, that it has been a bad thing for us, or for our manufacturers, that so many of us to-day are walking about in American boots. Our makers are not above taking a lesson, and improving upon it. I remember a similar invasion from France in the seventies; I remember how much good it did; and I also remember how short-lived it was. In the world of thought, we welcome every advance wherever it comes from, make it our own, and build upon it. Why should it be different in the world of industry?

I do not consider that we are losing our place among exporting nations. We must expect that countries which increase in population more rapidly than we do should increase their exports in the same ratio; if they do not do so they are falling behind, seeing that foreign trade is carried on, not by nations, but by individuals in the nation. Sir Alfred Bateman's figures, showing that, since 1875, the exports per head of the population of the four great nations have remained nearly stationary, namely, £6 for Great Britain, £3 15s. for France, £3 7s. for Germany, and £2 18s. for the United States, give us a valuable reminder of this, and show that, individual for individual, we are holding our place—with a long lead.

But even if we did not hold our own among exporting nations, it by no means follows that we are falling behind in comparative prosperity. Twenty years ago, your Chairman, in one of these suggestive and far-reaching essays, for which economic science owes him so much, said that "the possible loss of income from the entire loss of our foreign trade would be a most measurable, and by no means, a fatal injury." What he meant, of course, was that our foreign trade, after all, is only a fraction of our home trade; that an increasing demand for goods made at home might easily take up all the labour and capital of the country to meet its wants. The point is very significantly illustrated by the fact that America to-day, when she cannot meet all the

demand for steel at home, is more prosperous than she was last year when she was exporting it. In short, to quote Mr. Cannan's wise words: "When misleading metaphors and fallacies are dismissed, we are left with the facts that foreign trade—the trade of an area under one Government with areas under other Governments—is merely an incident of the division of labour, and that its magnitude and increase are no measures of the wealth and prosperity of the country, but merely of the extent to which the country finds it convenient to exchange commodities of its own growth or manufacture for commodities produced elsewhere."

DISCUSSION.

The CHAIRMAN, in opening the discussion, said the remark made by the author at a very early stage of his paper, whether it was not for municipalities to take over certain industries, which grew up to be monopolies, was a very interesting one, coming as it did from Professor Smart. He was afraid that if the Professor had gone further, and discussed the whole question as to what industries municipalities ought to take up, his conclusion might have been adverse to their taking up quite so much as they had done, especially in his own district in Glasgow, where he had had to fight the municipalising people very strongly. The paper had referred to the competition which had existed among different States of the American Union to facilitate the formation of public companies. In England, if possible, restraint was put upon public companies, and it was made as difficult as possible for a dangerous public company to come into existence and do business, but the United States, a big country with great capital and great opportunities, followed the very opposite principle of allowing joint stock companies to form themselves as and how they might, without any restriction or limitation of any sort or kind. One of the consequences would be, in certain directions, that the unrestricted American Company would come into competition with the limited English Company, and perhaps take from this side of the Atlantic business which would otherwise be done here. Mr. Pierpont Morgan's great shipping combination was all based upon the registration of a company in New Jersey, where he could do exactly what he liked. He (the Chairman) believed Mr. Pierpont Morgan would have found it a very serious matter if he had endeavoured to make the pivot of his combination the creation of a limited company in England, where he would have had to disclose everything, where everybody would have been able to follow all the proceedings in the register, where accounts would have been published, and the whole business brought to light. The unlimited American company was favoured by those who constituted companies, and who meant to do business, and that might attract some amount of business to the United States which would otherwise come to be established on this side. The author had referred to the rise and progress of the business millionaire, who he seemed to think was almost peculiar to the United States. He believed that was so to some extent, but it appeared to him that there were also such business millionaires in this country. He would mention the name of Sir Thomas Lipton as that of a man who had developed business on exactly the same lines as an American millionaire would do it; the same remark applied to Sir John Brunner and Dr. Mond, who were millionaires, who had made their own fortunes and stuck to business. He was not sure but that Messrs. Siemens might be mentioned in the same connection, although they were rather cosmopolitan or Anglo-German millionaires than peculiar to this country. There was also Sir Donald Currie, who seemed to him to some extent a gentleman of the same type that the author had referred to when he mentioned the American millionaire. He did not say that the same class of people was developed to the same extent in this country as in the United States, but possibly we were at the beginning of a time when the business millionaire would also become a phenomenon on this side of the Atlantic as well as on the other side, and when we might expect a repetition of the same processes of business which were in vogue on the other side of the Atlantic. Another remark he wished to notice was that with reference to large production being the connecting link of protection with trusts, that it was the opportunity of large production which led to the formation of trusts. He thought, to some extent, the formation of trusts had resulted as a consequence of protection, which was noted many years ago in the free trade discussions of this country. He thought Cobden, James Wilson, and other free trade authorities in this country 60 years ago, noted that one of the consequences of protection was a development of industry up to the point that there was a complete supply for the protected market, and that there was always a danger of a great fall of price, owing to the over-supply at different times. That was noticeable in agriculture. In bad seasons in agriculture, the supply was not sufficient. But so much capital had been brought into the business, and the power of production was so great, that when a good season came along, those who were protected were worse off by the artificial protection than they were before the protection came to them. As a means of relief, combination amongst those who were protected was quite natural, and that combination naturally led to the disposal of any surplus, when they had it, in foreign countries. It was a much older thing than anything which had been quite recently developed in the United States. With regard to the author's main argument, he thought they must have all heard with a great deal of satis-

faction, after the calm survey which he had made of all the phenomena of trusts and combines, which had caused so much alarm, that he had come to the conclusion that, as far as anything which had as yet taken place in this country was concerned, there was no cause whatever for fear—the combines had been a natural development, they had done as yet no great harm, and they were under no call to legislate in any special manner against them. As far as he could judge, the author's conclusion was well founded, and there was really nothing in all the combines which had taken place in this country to excite any alarm; they might be left to the working out of the processes of combination and competition. Some of the fears expressed about them seemed to him to be an echo of the old clamour against forestalling which took place many years ago with reference to wheat and many other articles. There was always alarm in the public mind against the possibility of artificial competition and against the combination of capitalists among themselves. Experience, however, showed that the evil could be left to work out its own cure. Such great combinations, if they threatened the public very much, were sure to break down some time or other, and the worst thing possible was to endeavour to make artificial laws against an evil which was certain to die out of itself. Of course those remarks did not quite apply to a country in the position of like the United States, where there were trusts as a consequence of protection, but the one remedy which was open to the United States, and which would relieve the situation a great deal, was to abandon the high tariffs, which would end the mischief almost at a stroke; so that there was no real danger to he apprehended on that account. The United States were quite ready, as was evidenced by their action in the coal famine, to remedy evils of that kind when they came to the unbearable point, as protection did in this country 60 years ago. If the United States were turning round now and abolishing the duties on coal for 12 months because the coal famine made the duty upon coal unbearable, it was quite reasonable to expect that in other matters they would show the same disposition, when they found that the tariff did no good to the country, but merely put money into the pockets of gentlemen like Mr. Carnegie and others, who were, no doubt, excellent gentlemen in many ways, but who had certainly done nothing remarkable to entitle them to such enormous sums of money as had been put into their pockets for no service at all to the community. He thought they must be satisfied with the conclusions the author had expressed with reference to the future of the industry of the country, with which he entirely agreed, that there was no sign of decay yet in the trade of the country, and the fact that they were doing more business at home instead of doing an increase of business with the foreigner was on the whole a good and not a bad thing.

Mr. L. N. COHEN thought the author had not allowed sufficiently for the distinction between the personal effort of those engaged in an industry, in which the profit in the main came to themselves, and salaried effort. If the author joined that incident of the essence of combine to the very large capitalisation which was almost unavoidably the consequence of such arrangements, he thought they would be still more confirmed in the view expressed by the Chairman, that they could, with some confidence, look to seeing the trusts finding, at a not very distant future, a proper limit to their useful and beneficial action. With reference to the hypothetical suggestion the author made as regards the possibility of a leaning towards municipalisation of various industries, he did not think the Professor had perhaps given attention to all the elective affinities associated with municipal organisation. When there was an urgent public want such as the better enforcement of statutory hygienic affairs connected with the housing question, considerations arose quite apart from pure economic ones; but when the author pleaded that it would be more advantageous if municipalities were substituted for combines or trusts he thought Professor Smart was not allowing sufficiently for the experience of the infirmities of human nature which were brought into play under such circumstances. It seemed to him that the author's remark in regard to the veto which existed under American legislation of favouring special traders was a very important feature, to which, in view of recent combines, special attention would need to be given. Traders who preferred to send their goods by ships outside of the combine, had a perfect right to expect the co-operation of their own Government to protect them in order to assure that equality of opportunity was afforded them, inasmuch as it was a feature of the laws of the country with which they sought to trade.

Professor SMART, in reply, said he was rather amused that he had succeeded in drawing the audience on the question of municipalities and monopolies. In his own city he enjoyed the reputation of being one who usually took the other side, but when an honest man saw an argument on the other side, he was bound to state it as strongly as he could. In speaking of the whole question, it seemed to him that if they had made up their minds that there would be nothing in the future but great monopolies, and that those great monopolies went into private hands, which would certainly take the highest prices and highest profits they could get, then there was an argument for municipalisation, if other things were equal. In Glasgow, they prided themselves on having so judicially managed their monopolies that the prices of some of the necessaries of life had been very effectively reduced, and they were not in the least afraid of some things which other cities were afraid

of. If anyone had said ten years ago that Glasgow would possess the tramway system it at present had very few would have believed it; but he thought the strongest opponent of municipal tramways would not now have any other system in the city of Glasgow. He only advanced that argument as a single point in the whole discussion, and rather from the side of a man who generally took the opposite view which an economist would. There were any number of arguments against general municipalisation, but it was claimed in Glasgow that they had shown to the rest of the world what could be done by the municipalisation of the gas, water, and tramways undertakings. If he had given a paper on the arguments for and against municipalisation it would have been very different from the one he had read that evening. With regard to the Chairman's remark about millionaires in this country, the factor of quantity was very strong. He was told that there were 4,000 millionaires in America, *i e*, millionaires in dollars, whilst in this country the great millionaires could be almost counted on the fingers of one hand. It seemed to him that the enormous power of the business millionaires in America was a thing to be afraid of if there was any prospect of such powers being exercised here, and if the race of millionaires went on increasing in this country, one did not quite see why the same powers should not be exercised. Mr. Cohen had called his attention to the place of the personal effort on the part of the small producer as against the combination. He did not mention that, because he thought very little, comparatively, was to be said for the success of the combines. It was the want of personal management which accounted for their want of success; the combines were breaking down where they were opposed by smaller men who devoted their whole time and thought to the busiuess. There was a limit to organisation, just as there was a limit to brain power. It was merely another element to prove his point that there was no need to have any fear whatever of the powers of combines in this country. He was more afraid of the power of monopolies over labour than of any of the powers he had mentioned; but he had not seen them put to any bad use hitherto. In regard to the question of the connecting link between trusts and tariffs and large production, for some time he could not see how there was any special connection between protection and trusts, or how it could apply to combines. But he had obtained a list containing, among others, the home American prices and the export prices of the following articles: — Meat - choppers, band - saws, gunpowder, borax, lead, wire, and sewing machines, and found there was an average difference of from 30 to 40 per cent. between the export and home prices, the lowest being a difference of 20 per cent. and the highest 210 per cent. in the case of refined borax. That, he thought, proved what he had said. In looking over the reports of the United States he had been particularly struck by the number of small exports, for almost everything was exported. They had been led to believe that a protective country could not export, but there was the fact that America apparently exported almost everything, which he could only account for by the explanation he had given, the possibility of exporting the surplus without loss, by reason of the stimulus given to larger production and cheaper cost.

The CHAIRMAN suggested that possibly some of the articles mentioned were first imported, and then exported again; such cases had happened.

Professor SMART said he had no doubt that accounted for some part of it. The list of articles exported closely corresponded with English exports. It was notorious that English manufacturers sold most of their goods at home, but exported a little of almost everything they made; and America followed in exactly the same line.

On the motion of the CHAIRMAN, a vote of thanks was accorded to Professor Smart for his paper.

Obituary.

LORD PIRBRIGHT, F.R.S.—Henry de Worms, first Baron Pirbright, died at his London residence, 42, Grosvenor-place, on Friday, 9th inst., after a long illness. He was born in 1840, and was elected a member of the Society of Arts at the early age of 17, in 1857. He was educated at King's College, London (of which he became a fellow in 1863), and in 1860 entered as a student of the Inner Temple, being called to the bar in 1863. In 1862 he published a work on the gyroscope, entitled "The Earth and its Mechanism; being an Account of the Various Proofs of the Rotation of the Earth." This book attracted the attention of Lord Brougham, who proposed Henry Worms as a Fellow of the Royal Society; but the latter was not elected to the Fellowship until 1895. In 1874 permission was given by Queen Victoria to his father, Baron Solomon Benedict de Worms, and his family to use their Austrian titles in England, and henceforth Henry Worms was known as Baron Henry de Worms. In 1882 he entered Parliament as one of the Conservative members for Greenwich, and he afterwards sat as member for the Toxteth (East) Division of Liverpool. In 1885 he was appointed Parliamentary Secretary to the Board of Trade in Lord Salisbury's first Administration. From 1888 to 1892 he was Under Secretary for the Colonies, and in 1888 he was added to the Privy Council and named with the then Premier (Lord Salisbury) as one of the plenipotentiaries of this country to the International Conference on Sugar Bounties. He was raised to the peerage in 1895.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at Eight o'clock :—

January 21.—"The Metric System." By A. Sonnenschein. Alexander Siemens will preside.

January 28.—"The Cost of Municipal Trading." By Dixon H. Davies. The Lord Chief Justice, G.C.M.G., will preside.

February 4.—"Methods of Mosaic Construction." By W. L. H. Hamilton.

February 11.—"The Port of London." By Dr. B. W. Ginsburg. Alderman Sir James Thomson Ritchie will preside.

February 18.—"Three-Colour Printing." By Harvey Dalziel. Carmichael Thomas will preside.

Indian Section.

Thursday Afternoons, at 4.30 o'clock :—

January 22.—"Indian Domestic Life." By John David Rees, C.I.E. The Lord Harris, G.C.S.I., K.C.I.E., will preside.

February 26.—"Gleanings from the Indian Census." By Jervoise Athelstane Baines, C.S.I.

Colonial Section.

Tuesday Afternoons, at 4.30 or 5 o'clock :—

February 10, at 5 p.m.—"Women in Canada." By the Countess of Aberdeen. The Rt. Hon. Leonard H. Courtney, M.A., M.P., will preside.

March 3, at 4.30 p.m.—"The Uganda of To-day." By Herbert Samuel, M.P. Sir Harry H. Johnston, G.C.M.G., K.C.B., will preside.

Applied Art Section.

Tuesdays, at 4.30 or 8 o'clock.

January 20. 8 p.m.—"Principles which should guide all Applied Art." By G. F. Bodley, R.A.

February 3. 4.30 p.m.—"Technical Education in connection with the Book-producing Trades." By Douglas Cockerell. Prof. William Garnett, M.A., D.C.L., will preside.

Cantor Lectures.

Monday Evenings, at Eight o'clock :—

Julius Hübner, "Paper Manufacture." Four Lectures.

February 2, 9, 16, 23.

MEETING FOR THE ENSUING WEEK.

Monday, Jan. 19...British Architects, 9, Conduit-street, W., 8 p.m. Professor H. E. Armstrong, "Science Workshops for Schools and Colleges."

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. H. G. Griswold, "The Arya Samaz, or the Reform Movement in India."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. H. Belloc, "The City of Paris."

Tuesday, Jan. 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. G. F. Bodley, "Principles which should guide all Applied Art."

Royal Institution, Albemarle-street, W., 3 p.m. Professor A. Macfadyen, "The Physiology of Digestion." (Lecture II.)

African Society, United Service Inst., Whitehall, S.W., 4 p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on "Electric Automobiles."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Hon. T. A. Brassey, "The Finances of Federal Government for the United Kingdom."

Photographic, 66, Russell-square, W.C., 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. J. S. Budgett, "Report on his Expedition to Uganda." 2. Mr. F. E. Beddard, "The Brain of *Nasalis* and some other Old-World Monkeys." 3. Mr. G. A. Boulenger, "The Fishes collected by Mr. G. L. Bates in Southern Cameroon." 4. Mr. W. K. Hutton, "The Anatomy of the Gephyrean *Phascolosoma teres*, n. sp."

Wednesday, Jan. 21...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. A. Sonnenschein, "The Metric System."

Meteorological, 25, Great George-street, S.W., 7½ p.m. Address by the President, Mr. W. H. Dines, B.A., "The Method of Kite-Flying from a Steam Vessel and Meteorological Observations obtained thereby off the West Coast of Scotland."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. Inaugural Address by the President.

Entomological, 11, Chandos-street, W., 8 p.m. President's Address.

Archæological Association, 32, Sackville-street, W., 8 p.m.

Thursday, Jan. 22...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. John David Rees, "Domestic Life in India."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Chemical, Burlington-house, W., 5½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Dr. F. J. Sawyer, "The Folk Songs of the English Village."

Royal Institution, Albemarle-street, W., 3 p.m. Dr. A. J. Evans. "Pre-Phœnician Writing in Crete, and its Bearings on the History of the Alphabet." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on the Metric System.

Friday, Jan. 23...Royal Institution, Albemarle-street, W. 8 p.m. Weekly Meeting, 9 p.m. Dr. Tempest Anderson, "Recent Volcanic Eruptions."

North East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7.40 p.m. Mr. Joseph H. Pescod, "Minimum Metacentric Heights in small Vessels."

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m. 1. Mr. W. H. Derriman, "The Oscillating Table for determining Moments of Inertia." 2. Prof. L. R. Wilberforce, "Note on an Elementary Treatment of Conducting Networks." 3. Mr. G. W. Walker, "The Theory of the Quadrant Electrometer."

Saturday, Jan. 24...Royal Institution, Albemarle-street, W., 3 p.m. Sir Frederick Bridge, "The Bi-Centenary of Samuel Pepys: His Musical Contemporaries, Criticisms, and Compositions." (Lecture II.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

WEDNESDAY, JANUARY 28, 8 p.m. (Ordinary Meeting.) DIXON H. DAVIES, "The Cost of Municipal Trading." The LORD CHIEF JUSTICE, G.C.M.G., in the chair.

Further details of the Society's Meetings will be found at the end of this number.

APPLIED ART SECTION.

Tuesday, January 20, 1903, 8 p.m. LEWIS FOREMAN DAY, Vice-President of the Society, in the chair. The paper read was "Some Principles that may be Guides for the Applied Arts," by G. F. BODLEY, R.A.

The paper and report of the discussion will be published in the next number of the *Journal*.

INDIAN SECTION.

Thursday, January 22, 1903, 4.30 p.m. The LORD HARRIS, G.C.S.I., K.C.I.E., in the chair. The paper read was, "Indian Domestic Life," by JOHN DAVID REES, C.I.E.

The paper and report of the discussion will be published in a future number of the *Journal*.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

Proceedings of the Society.

SEVENTH ORDINARY MEETING.

Wednesday, January 21, 1903; ALEXANDER SIEMENS, M.Inst.C.E., M.Inst.E.E., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society :—

Atchison, Arthur F. T, Cooper's-hill, Englefield-green, Surrey.
Cater, Herbert Elliott, B.A., Southdown, The Downs, Wimbledon, S.W.
Day, Harry Daborn, Railway Approach, Godalming, Surrey.
Eliot, Sir Charles Norton Edgcumbe, K.C.M.G., C.B., Government-house, Mombasa, East Africa.
Fletcher, Banister Flight, 29, New-bridge-street, E.C.
Ford, Albert, Welsbach Light Company of Australasia, Limited, Wellington, New Zealand.
Isherwood, William Herbert, 18, Wrangthorn-terrace, Hyde-park, Leeds.
Russell, Charles Bartlett, 16, Teignmouth-road, Brondesbury, N.W.
Toogood, John F., F.R.G.S., Bipposu Mines, Ltd., Ashanti, West Africa.
Walsh, Albert, P.O. Box 39, Cape Town, South Africa.
Wilson, William, 1, Belmont-street, Chalk Farm, N.W.

The following candidates were balloted for and duly elected members of the Society:—

Bale, Hon. Sir Henry, K.C.M.G., K.C., Ingleside, Pietermaritzburg, Natal, South Africa.
Causton, Harry, Clive-street, Tunstall, Stoke-on-Trent, Staffordshire.
Chambers, Walter Ashbridge, 1, Medow-street, Fort, Bombay, India.
FitzSimons, F. W., F.Z.S., The Museum, Pietermaritzburg, Natal, South Africa.
Halse, Sidney Joseph, A.R.I.B.A., 60, Margaret-street, Cavendish-square, W.
Mudaliar, P. Ramanatha, B.A., Manônmani Vilas, Chintadripet, Madras, India.
Pears, Francis, Lanadron Estate, Muar, viâ Singapore, Straits Settlements.
Perkins, Charles Clifforde, M.I.Mech.E., 6N Bickenhall-mansions, W.
Powell, Edmund, Cambria, Claremont, Cape Town, South Africa.
Sadler, Lieut.-Colonel James Hayes, C.B., H.M. Commissioner for the Uganda Protectorate, Entebbe, Uganda, British East Africa.
Stoneham, Herbert S., 70, Cornhill, E.C.
Tudman, Albert Richard, A.M.I.E.E., Electricity Works, Colwyn Bay, North Wales.
Waddom, Thomas, Knowestone, Gosforth, Newcastle-on-Tyne.

The paper read was—

THE METRIC SYSTEM.

By A. Sonnenschein.

The history of the metric system in this country is very curious and instructive; we have been dallying with it for half a century; twice it has been made permissive by Act of Parliament; its adoption is advocated by influential merchants, by Chambers of Commerce, and by many eminent men of science; it is, and has been, opposed by great thinkers of European reputation, notably by the late Sir John Herschel, and by Mr. Herbert Spencer; nevertheless, with so much stir and zealous discussion *pro* and *con.*, in the press and elsewhere, no appreciable progress has been made, and we seem no nearer to a final decision either way than we were fifty years ago. And yet both the advocates and the opponents of the metric system are agreed that our present want of system is productive of endless trouble, confusion, and much loss of time. It seems that the natural inertia of the so-called practical man "makes him rather bear those ills he has, than fly to others that he knows not of."

Let us examine the ills entailed by our present practice.

Our Nomenclature.—It is often perplexing to the point of being unintelligible, *e.g.* There are several kinds of miles, the geographical, the nautical, and the statute mile, to say nothing of the Scotch and the Irish miles, but there is only one kilomètre; there are four different kinds of ells, besides the yard, foot, and fathom, but there is only one mètre; there are several kinds of lbs., stones, cwts., &c., but there is only one kilogram; we have different measures of capacity for dry goods, and also for wet goods, but there is only one litre, and so on.

Again, one and the same term often has different meanings, thus:—A fodder of lead weighs, in London and Hull, $19\frac{1}{2}$ cwts.; in Derby, $22\frac{1}{2}$ cwts.; in Newcastle, $21\frac{1}{2}$ cwts., and so on.

Finally, different trades adopt different subdivisions of the same unit, *e.g.*, the draper has $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$ yards; $\frac{1}{16}$ yard $= 2\frac{1}{4}$ inches is called a nail, but the carpenter, timber merchant, and others have yards, feet, and inches, and the mariner has fathoms, and so on; whilst the metric system has uniform sub-divisions for all magnitudes.

These varying units and practices lead to grave inconvenience in:—

(*a.*) *The Markets, both Wholesale and Retail.*—On the 1st of July, 1862, Mr. Bass, the brewer, said in his evidence before the Royal Commission on Weights and Measures: "I live within twelve miles of the city of Lichfield; when I see the quotations of the prices of corn at Lichfield, I do not know what they mean. I have to make a calculation, just the same as if I were buying in Hungary by the *metzen*."

Professor De Morgan, on June 24th, 1862, in his evidence to the same Commission, enumerates no less than 154 different uncouth sounding units used in various parts of the country, no one man possibly knowing all, or even many of them (Appendix II.). Does not such a state of things obviously increase the British merchant's difficulty of "buying in the cheapest, and selling in the dearest market."

In the retail market the inconvenience due to our chaotic usages assumes an almost pathetic aspect. Let anyone, who is a fairly rapid computer, go of a Saturday night into those thoroughfares where the working men's wives congregate to make their little purchases, and witness the over-reachings practised on them in the calculations of their purchases. I quote actual cases: 7 lb. 11 oz. of scraps at 5d. per lb. amounts accurately to 3s. $2\frac{7}{16}$d., so that 3s. $2\frac{1}{2}$d. would be an overpayment; it was charged 3s. $3\frac{1}{2}$d., and the purchaser was mulcted in 1d.; a piece of cheese weighing 2 lb. 3 oz. at $6\frac{1}{2}$d. per lb. costs accurately 1s. $2\frac{7}{32}$d., so that 1s. $2\frac{1}{4}$d. is an over-payment; it was charged 1s. 3d. These habitual, intentional over-reachings are considered, if not commendable, at least venial "trade-practice."

(*b.*) *In the Counting-house.*—It has been proved that the calculations on a non-decimal system are far more complex, and take, on an average, nearly half as long again as on a decimal system; hence our practice of using "ready reckoners," which often are very unready, and are wholly unknown on the continent, as Mr. Cobden pointed out some forty years ago. Moreover, they involve inaccuracies, which are not always inappreciable; for example: In calculating interest, amounts below 10s. are ignored, and 10s. and upwards are called £1; for a bill of short date and a low rate the difference is a *quantité negligeable* but not otherwise; thus the interest on 10s. at five per cent. for half a year is 3d., which is appreciable, but calculated decimally, the error can in all cases be brought to below a farthing, and with less labour too.

(In the laboratory and in scientific books and investigations generally the inconvenience is no longer felt, because men of science have adopted the metric system and its decimal divisions to the exclusion of every other.)

(*c*.) *In our Foreign Trade.*—The foreign customer is worried and annoyed by our, to him, unintelligible systems, and is familiar with the system of our rivals. In consequence of this "splendid isolation" of ours many English firms now publish double price lists, in metric and in English units, involving labour and expense.

(*d*.) *In the School-Room.*—The children are made to learn by heart a number of certain selected tables, and have to work complicated problems on them, requiring at times the anticipation of future, more advanced studies, as, for example, when they have to divide by $5\frac{1}{2}$ or $2\frac{1}{4}$ before they have studied fractions. Nine-tenths of the tables they learn they will never want, and such tables as they will require they learn best by the daily use in the business they will in future years engage in. I don't think I overstate the case if I estimate the loss thus incurred as equivalent to the waste of one year's arithmetical studies. I will say nothing now of the exclusion of the advantages derivable in the school-room from the introduction of the metric system, as those will be mentioned when we come to it.

Ere I proceed to discuss the metric system allow me to state, as succinctly as I can, what, I submit, ought to be the properties of an ideally perfect system of weights and measures :—

(*a*.) The fundamental unit should be a "natural" unit, recoverable if at any time it were lost. It does not seem to me that much value need be attached to this requirement. If we have a well-guarded and accessible standard somewhere—say at Westminster—and authentic, equally accessible, copies of it in every important commercial centre of the empire, all danger of its being lost is amply provided against.

(*b*.) The nomenclature should be simple so as to be easily "understanded of the people," and the several designations should be as different from each other as possible.

(*c*.) The units should be convenient in use ; thus the unit of length should bear some relation to the average length of the human arm ; the weight of a sack of corn to the average strength of a man's back and so on.

(*d*.) The different units of length, capacity, and weight should be interdependent and easily derivable from each other.

(*e*.) The multiples and sub-multiples should be uniform all through, and convenient for calculations in both the home trade, which is mostly retail trade, and in the foreign trade, which is entirely wholesale ; but as the retail trade demands binary sub-divisions, in consequence of the very natural habit of "splitting the difference," and the wholesale trade requires, for the purpose of easy calculation, mainly decimal sub-divisions, an ideally perfect system of weights, measures, and coins should satisfy, or at least offer an endurable compromise between these two apparently irreconcilable demands.

Let us now examine in how far the metric system satisfies, and fails to satisfy the requirements here enumerated.

The Metric System.

It came into being during the French Revolution in 1790, and was elaborated by the French *Académie des Sciences*. The fundamental unit is the length called the mètre. It was intended to be the 10,000,000th part of the quadrant of Paris, but was subsequently found to be slightly inaccurate, so that, like ourselves, France also has had recourse to official standards, preserved in the Hôtel de Ville, of Paris. It is to be regretted that this unit is a national, not a universal unit. Had the French Academy started from the polar axis of the earth, as Sir John Herschel suggests, this reproach would have been avoided.

Finally, it must be urged against this unit that it is somewhat too long for the average length of the human arm. I have seen cloth measured in Germany on the half-mètre, because the whole mètre was too long for the woman's arm. These defects seem irremediable, but are, after all, not intolerable, and if we put up with them, we derive from a partial adoption of the metric system, and from adapting it to our requirements, numerous advantages which greatly overbalance these disadvantages. These advantages are :—

1st. The multiples and sub-multiples are uniform, and easy for calculation, being decimal.

2nd. The units of capacity and of weight are readily derived from the one fundamental unit, the mètre.

Thus the mètre is divided into 10 decimètres, 100 centimètres, and 1,000 millimètres ; again, 10 mètres form a decamètre, 100 mètres a hectomètre, and 1,000 mètres a kilomètre.

The unit of capacity, the litre, is a cubic decimètre.

Its sub-multiples are:—

$\frac{1}{10}$ litre, called a decilitre;
$\frac{1}{100}$,, ,, centilitre;
$\frac{1}{1000}$,, ,, millilitre (a cubic centimètre);

Its multiples are:—

10 litres form a decalitre;
100 ,, ,, hectolitre;
1,000 ,, ,, kilolitre (hardly ever used).

The unit of weight, the gram, is a cubic centimètre of water at maximum density; it is divided into 10 decigrams, 100 centigrams, and 1,000 milligrams; 10 grams form a decagram, 100 form a hectogram, and 1,000 form a kilogram (hence a litre of water at maximum density weighs a kilogram); 10,000 grams form a myriagram, 100,000 form a quintal, and 1,000,000 form a metric ton, which differs but slightly from our English ton avoirdupois. And this is the whole; by means of some such visualisation as this which is now exhibited before him, the dullest child can learn and remember the metric system in two or three lessons.

The metric nomenclature is objectionable. The French *savants*, anxious to make their system international, refused to employ French terms, which many millions in France and out of it would have understood, but adopted Latin and Greek terms, which hardly any one understands. They might wisely have left it to each nation to invent its own nomenclature. Moreover, the expressions often sound so much like each other, that the risk of confusion is not inconsiderable. The difference between "decagram" and "decigram," "decalitre," and "decilitre," and the like, consists in one single letter. Again, we are familiar with the cartoon in *Punch*, where an English couple in a Paris shop order one kilomètre of sausages. A blunder as amusing as it is easily committed.

As for the French coins (the franc with its ten décimes and 100 centimes) is wholly inadmissible, and forms no integral part of the metric system. Many foreign nations who have adopted the metric system have a money currency entirely their own. Germany has the mark of 100 pfennige, Austria the krone of 100 hellers, &c.

If we adopt the metric system, or rather adapt our system to it, I earnestly desire that we shall not abandon our currency, which I hope to prove to you is the best in existence, and ought to be copied *in toto* by all other nations.

In the schoolroom it would be difficult to over-estimate the benefits flowing from a visualisation of the metric magnitudes and their multiples and sub-multiples. The release from the practice of learning senseless tables by heart is the smallest part of our gain. By means of some apparatus, such as the one before you, the teacher can visualise most, if not all, the operations of arithmetic. As this meeting has not been called to discuss methods of teaching arithmetic, I must refrain from entering into details; but I may add that numeration and notation, the four rules (as they foolishly are called), the multiplication table, decimal fractions, terminating and recurring, and approximations can all, by means of some such apparatus, be taught heuristically and intuitionally. Even specific gravity, which children find so hard to understand, can be taught by it with surprising ease. I think I have said enough to shew that the balance of advantages over disadvantages caused by the adoption of the metric system is great enough to induce us to make the change.

I now wish to draw your attention to a useful fact in the metric system, which not only enables us easily to adapt our unit of length to it, but also combines the advantages of binary with decimal subdivisions right through the whole system.

The length of the mètre is 39·37079 English inches, therefore the decimètre is 3·937079 English inches long. Now, $3·937079 \div 4 = ·984269$, and $1 - ·984269 = ·015731$, which is less than $\frac{1}{60}$. If, then, we reduce the size of our inch by this very small quantity, calling it, if you please, the "new inch," then we obtain a—

Mètre of exactly 40 "new inches," which gives us three halvings in addition to its usual decimal subdivisions.

The *Litre, i.e.*, the cubic decimètre, would give us 64 "new inches" cubed, which gives us six halvings besides its decimal submultiples.

The *Are, i.e.*, the decamètre squared, would give us 400 × 400 "new inches," square, which yields 8 halvings besides its decimal subdivisions.

The *Hectare, i.e.*, the hectomètre squared, would yield 10 halvings besides its decimal subdivisions.

We are thus enabled to combine binary with decimal subdivisions of one and the same unit, which is no doubt a boon to both the wholesale and the retail trade.

Finally, I have to deal with our currency, where I am able to speak favourably in every way. Its advantages are so numerous

and great that the few trifling drawbacks cease to be of any moment. To deal first with the drawbacks. Addition and subtraction are a little harder for children to learn than "simple addition and subtraction," and that is really all.

Now the advantages :—

A. In mental arithmetic—

(*a.*) *Dozens.*—Very many things are sold by the dozen ; even the French sell their wines by the dozen bottles.

Rule.—As many pence the piece, so many shillings the dozen, and conversely : as many shillings the dozen, so many pence the piece. Examples :—

Piece.	Dozen.
3d.	3/-
$7\frac{3}{4}$d.	$7\frac{3}{4}$/- = 7s. 9d.
1·$3\frac{1}{2}$ = $15\frac{1}{2}$d.	$15\frac{1}{2}$/- = 15s. 6d.

(*b.*) *Scores, e.g.*, tons. Rule.—As many shillings the piece, so many £'s the score, and conversely : as many £'s the score, so many shillings the piece. Examples :—

Cwts.	Tons.
1/-	£1
1/6 = $1\frac{1}{2}$/-	£$1\frac{1}{2}$ = £1 10s. 0d.
1/8 = $1\frac{2}{3}$/-	£$1\frac{2}{3}$ = £1 13s. 4d.

(*c.*) *Discounts in the Retail Trade.* Rules.—5% = 1/- on £1, 6d. on 10/-, 3d. on 5/- (amounts under 5/- are ignored.) Examples : Allow 5 % discount on £17 10s. *Answer :* 17s. 6d. Allow 5 % discount on £19 15s. *Answer :* 19s. 9d. $2\frac{1}{2}$ % = 6d. in £1, 3d. in 10s. (amounts under 10s. are ignored) Examples : Allow $2\frac{1}{2}$ % discount on £8 13s. *Answer :* 4s. 3d.

Interest. Rule.—5 % amounts to 1/- per £1 a year, and 1d. per £1 a month. Examples : Find interest on £125 at 5 % for six months. *Answer :* $\frac{1}{2}$ of £6 5s. = £3 2s. 6d.

2. Find interest on £94 at 5 % for 2 months. *Answer :* 2 × 7/10 = 15s. 8d.

3. If a usurer charges me 6d. per £1 per month, what is the rate of interest ? *Answer :* 6 × 5 % = 30 % per annum.

$2\frac{1}{2}$ %, $3\frac{3}{4}$ %, 3 %, &c., are easily derived from 5 %.

N.B.—$2\frac{1}{2}$ % is the interest paid by the Post Office Savings Bank, and the thrifty depositor knows that his money increases at the rate of $\frac{1}{2}$d. per £1 per month.

Examples :—

1. Find interest on £75 at $2\frac{1}{2}$ % for 7 months. *Answer :* $\frac{1}{2}$ of 7 × 6/3 = 7 × 3/$1\frac{1}{2}$ = £1 1s. $10\frac{1}{2}$d.

2. Find interest on £90 at $3\frac{3}{4}$ % for 8 months. *Answer :* $\frac{3}{4}$ of 8 × 7/6 = 6 × 7/6 = £2 5s.

3. Find interest on £85 at $3\frac{1}{2}$ % for 5 months. *Answer :* $\frac{7}{10}$ of 5 × 7/1 = $\frac{7}{2}$ of 7/1 = $\frac{1}{2}$ of £2 9s. 7d. = £1 4s. $9\frac{1}{2}$d.

4. What rate of interest am I charged if I pay $4\frac{1}{2}$d. per £1 per month ? *Answer :* $4\frac{1}{2}$ × 5 % = $22\frac{1}{2}$ % per annum.

B. In Written Calculations.—Our coinage is already so nearly decimal that any number of shillings, pence, and farthings can be written down, *currente calamo*, as a decimal fraction of £1 ; thus, 13s. $9\frac{3}{4}$d. = £·690625, and from it can be read off as follows : If 1 thing costs 13s. $9\frac{3}{4}$d., 10 things cost £6 18s. $1\frac{1}{2}$d. ; 100 things cost £69 1s. 3d. ; 1,000 things cost £690 12s. 6d. ; 10,000 things cost £6,906 5s. ; 100,000 things cost £69,062 10s., and 1,000,000 things cost £690,625.

For other calculations, such as any number of articles at any price, or interest, &c., see Appendix I.

In our circulating medium, however, it would be desirable, in order to avoid intentional or accidental disputes, to drop either the half-crown or the florin. From enquiries I have made, I find that most small traders would prefer retaining the florin and dropping the half-crown, just as the 4d. piece was called in, because it collided with the 3d. bit.

Another source of trouble is that by gaslight the half-sovereign, the sixpence, and the new farthing get in each other's way, and some means ought to be devised by the Mint to obviate this inconvenience.

On Difficulties attending the Adoption of the Metric System.

1. Every retail trader would have to supply himself with new sets of weights or measures, the cost of which would in some cases amount to £1 or £1 10s., not a trifling consideration.

2. Every counting-house would have to be supplied with new sets of account books, which, according to some evidence given to the above-named Royal Commission, would in some counting-houses cost some £500 ; but this heavy outlay would, unless I am much mistaken, be largely reduced if we retain our coinage.

3. All the quantities booked in old units might have to be translated into the metric units ; an unpleasant prospect, but happily the work would be transitory and less serious than it looks at first sight, because the ratio between any two magnitudes can be established once for all, and then each case would be reduced to a mere multiplication. Manuals

for that purpose would speedily appear in shoals.

4. The introduction of a new system must involve in numerous cases of daily occurrence a change in the practice and habits of thought to every member of our community, however humble his station or pursuits; indeed, the humbler his daily commercial transactions are, the more irksome the change will appear to him. This aspect of the question seems the most formidable, and would require careful and circumspect management. Still, the difficulty has been overcome in other countries, why should it be insurmountable in this country?

Reply to Objections.

(*a*.) In 1863, Sir John Herschel published a pamphlet, in which he opposes the introduction of the metric system on two grounds; first, because he shrinks from an innovation which would incessantly interfere with the ingrained habits of the people; and secondly, because the metric system is "national" and not "universal." Instead of it he proposes, if a change is to be made, to choose the axis of the earth as the basis of his system, which would of course be universal, and also most convenient to this country, as we should only have to increase our inch by ·001 of an inch; and if a sensible nomenclature were invented, there can be no doubt that the acceptance of Sir John Herschel's system would at the time have been an invaluable boon to the country; but the opportunity was allowed to slip, and since that time a number of nations have committed themselves irrevocably to the only system that was before them; and unless we desire to occupy in commerce also a position of "splendid isolation," we have no choice but to stand in line with the other nations, viz.: France and Belgium, Germany, Austria-Hungary, Italy, Portugal, Spain, Sweden and Norway, and a lot of small fry.

(*b*.) In a pamphlet, "Against the Metric System," by Herbert Spencer, published in 1896, I find that, in his opinion, the introduction of the metric system must, of necessity, bring in its train the centigrade thermometer, with its, according to him, unsatisfactory zero-point; but the metric system has as little to do with the position of the zero-point on the thermometer, as it has with Papal infallibility or with the Protestant succession.

Next, Mr. Spencer urges that the metric system militates against the sexagesimal division of the circle, against the binary divisions of the mariner's compass, against the duodecimal divisions of time, viz., 12, or 2 × 12 hours in the day, 12 months and 12 lunations in the year. One wonders that he has omitted the twelve tribes of Israel and the twelve Apostles, because they have as much to do with the metric system as the instances that he adduces. Next he emphasises the comparative lack of binary sub-divisions, which I have already dealt with.

Mr. Herbert Spencer's remedy is that we should alter all our arithmetical calculations, and work on the duodecimal scale. Here is a revolution with a vengeance. Of course, the duodecimal scale has many advantages over the familiar decimal scale, but unfortunately we have ten, not twelve fingers, and consequently nearly all nations count by tens. From this it follows that numbers written on the ten-scale, can be read off with ease, whilst numbers written on the twelve-scale involve some labour, and are difficult for children to understand. For example, the symbols 3456 on the ten-scale can be read off by any child as three thousand, four hundred and fifty-six, but on the twelve scale it would mean: 6 units, 5 dozen, 4 gross, and three great-gross, amounting in all to 5,826. This fact alone, besides many other inconveniences attending duodecimal calculations, is fatal to its adoption. Indeed Mr. Spencer himself admits that his proposal would not be accepted for several generations, and thereby he puts himself out of court. The adoption of the metric system by so many nations does not, as he thinks, prove a general recognition of its usefulness, but is an instance of the "triumph of bureaucratic tyranny," and he adds that the metric system was introduced into Germany during the Bismarck régime, and consequently we may be sure that it was forced upon the people.

On the face of it, this seems absurd, as it is hard to see what personal, social, or political object Bismarck can have had in desiring its adoption. I made enquiries, and received the following reply from Professor Kirchhoff, the eminent Professor of Geography of the University of Halle:—

"The metric system has, of course, been introduced into the German Empire during Bismarck's rule, but as far back as 1860, that is before Bismarck had entered the Prussian Ministry, the metric system was already in *official* use in Germany, and the Prussian Government caused its standard to be tested by the standard in Paris; and then it was set up as Norm for home use. And before Government had taken any action in the matter, the mètre had already

taken deep root in German technical and scientific works and pursuits, and pre-eminently in the science of geography, without any impulse from without, solely on account of its simple and definite nomenclature, whilst our own terms, 'mile' 'foot,' &c., required some additional description to make them clear."

Another objection urged by Mr. Herbert Spencer is that the operator on decimal fractions is liable to misplace the decimal point, but this danger will also exist if he worked with duodecimal fractions; but in either case such an error could not fail to be instantly detected, if the calculator is, as he ought to be, in the habit of always making a rough guess at the result to be expected. For example:—If he has to find the cost of 1,000 things at 4s. $3\frac{1}{2}$d. The answer is £$\cdot 21458\dot{3} \times 1000 =$ £214 11s. 8d.

A misplacement of the point by one place would yield either £21 9s. 2d. or £2,145 16s. 8d. As his rough guess tells him that his answer must lie between £200 and £250, he can at once see the nature of his error.

P.S.—Since writing the above, I have been shown a correspondence in *The Lancet*, where a number of medical men advocate the adoption of the metric system in pharmacy, and assure us that the transition could be easily effected. The correspondence was opened by Sir William R. Gowers, and his views were supported by all subsequent correspondents without exception.

Appendix I.

Illustrative Examples.

(*a*) 1000 articles at $11/5\frac{3}{4}$.

By Decimals.

£$\cdot 573958\dot{3} \times 1000$
= £573 19 2.

7 figures used.

By Practice.

		£	s.	d.
1000 ×	10s.	£500	0	0
1000 ×	1s.	50	0	0
,,	4d.	16	13	4
,,	1d.	4	3	4
,,	$\frac{1}{2}$d.	2	1	8
,,	$\frac{1}{4}$d.	1	0	10
		£573	19	2

19 figures used.

(*b*) 7000 × 12/10.

By Decimals.

£$641\cdot 6 \times 7 =$ £$449\dot{1}\cdot\dot{6}$
= £4491 13 4

10 figures used.

By Practice.

		£	s.	d.
7000 ×	10s.	£3500	0	0
,,	2s.	700	0	0
,,	8d. ...	233	6	8
,,	2d. ...	58	6	8
		£4491	13	4

17 figures used.

(*c*) 1529 × £1 7 $10\frac{3}{4}$.

By Decimals.

```
1·394791̇6
      9251
----------
  13947917
   6973958
    278958
    125531
----------
2132·6364 = £2132 12 8¾.
```

47 figures used.

By Practice.

	£	s.	d.
1529 × £1	1529	0	0
5s.	382	5	0
2/6	191	2	6
3d.	19	2	3
$1\frac{1}{2}$d.	9	11	$1\frac{1}{2}$
$\frac{1}{4}$d.	1	11	$10\frac{1}{4}$
	£2132	12	$8\frac{3}{4}$

30 figures used.

(*d*) 15 tons 17 cwt. 3 qrs. 12 lb. at 35/9 per ton.

By Decimals.

```
15·890625      ·015625
 ·00223        1·7875
---------
15·89285
  57871
---------
 158929
  11250
  12714
   1112
     79
---------
28 4084 = £28  8  2
```

54 figures used.

By Practice.

	£	s.	d.
15 tons at £1...	£15	0	0
10s. ..	7	10	0
5s. ..	3	15	0
6d...		7	6
3d...		3	9
10 cwts.		17	$10\frac{1}{2}$
5 ,, ...		8	$11\frac{1}{4}$
2 ,, ...		3	$6\frac{9}{10}$
2 qrs..................			$10\frac{29}{40}$
1 qr.			$5\frac{29}{80}$
7 lb.			$1\frac{109}{320}$
1 lb.			$\frac{429}{2240}$
4 lb.			$\frac{429}{560}$
	£28	8	$2\frac{1}{28}$

73 figures used, besides 60 figures used in adding up the fractions, in all 133 figures.

(*e*) Find the Interest on £437 at $3\frac{3}{4}$% for 57 days.

By Decimals.

$$4\cdot 37 \times \frac{3}{4} \times \frac{57}{73}$$

```
4)13·11          73)570(·7808
  3·2775             590
  28027              —600
 -------               16
  22943
   2622
     27
 -------
2·5592 = £2 11 2¼
```

48 figures used.

By Practice.

$$437 \times \frac{3}{4} \times \frac{57}{73}$$

```
1311 × 57
---------
6555 .
---------
73)74727(1023 13 1 59/73
   172
    267
    48
   ----
    96
    230
    11
   ----
    132
     59              132

   4)1023 13 1 59/73
100)2 55 18 3 132/292 | 33/73
    --------------------------
      11,18 3 33/73     73 × 19
       2)19             -------
      ---------          1387
         142 72            33
        --------        -------
         730 365         1420
```

Answer £2 11 $2\frac{71}{365}$.

116 figures used.

(*f*) Find Dividend at £7 11 $2\frac{1}{4}$% on £67 13 5.

By Decimals.	By Practice.
67·67083̇ × ·0757̇9375	
49557·	Labour too great to work by usual process; it would cover a whole page.
47369	
3384	
338	
62	
5·1153 = £5 2 $3\frac{3}{4}$.	

Comment.—The number of figures used is not always a criterion of the time required; the working by decimals follows a uniform process, and requires no previous scheming and perpetual change of operation, as is the case with the complex working by "Practice."

Problem (*f*) is not an imaginary case. I have had to work hundreds of problems of that kind once every year for a building society that made no reserve fund and distributed the whole of each years's profit to every shareholder *pro rata* of the amount for which he stood credited.

Appendix II.

In his evidence before the Select Committee of the House of Commons in 1862, Professor De Morgan referred to a long list of weights and measures actually in use, though not generally known, in various parts of the country. He said (Minutes of Evidence before the Committee, p. 151):—

In 1820 Dr. Thomas Young collected, for the Commissioners of Weights and Measures, a list of the weights and measures not known to the law, not known to the mass of the people, but existing in different parts of the country, by which people bought and sold. The secret of this is that every cask or box that was usually made of one particular size came to be called a measure, and ultimately passed as a measure. Those enumerated by Dr. Young are the awm; bag, bale, basket, bat, bay, beatment, billet, bind, bing, boll, bolt, bolting, bottle, bout, box, bucket, bunch, bundle, burden; cabot, cade, canter, caroteel, carriage, cart, cartload, case, cast, cheef, chest, clue, cord, corf, cran, cranock, cut, cyvar, cyvelin; daugh, dish, drop, dupper; erw; faggot, fall, fan, flask, fodder, fotmal, frazil; garb, gaun, glean, gunny, gwaith-gwr; hank, head, heap, hide, hobed, hoop, hutch, hyle; incast, ingrain; jar, jug; keel, kemple, kenning, kibin, kishon, kiver, knot; lay, leap, lispound, llath, llathen, gyvelin, llestraid, lug; maen, maise, mark, mast, math, measure, meer, meiliaid, merk, mount, mug; oxland; pack, packet, paladr, pared, peccaid, peget, piece, pig, ploughland, pocket, poke, pot, pwys; quintal; reel, rees, rhaw, ridge, role, rope, roul; sack, saume, sester, sieve, skain, skin, skron, sleek, spindle, square, stacca, stack, staff, stang, stick, stimpart, stook, stored, sum; table, talshide, tankard, teal, thrave, thread, threave, timber, topston, truss, tub, tunnell; vergée, vragina; waggon-load, wain, warp, web, weight, and windle; in all, 154. These were actually in use in 1820; how many have become obsolete we cannot tell. The dole, for example, is not among them, but it existed in the seventeenth century.

DISCUSSION.

Sir Guilford Molesworth, K.C.I.E., did not agree with the author that the English system of currency was the best. He considered that a change in our currency was not desirable at present, but he regarded the French system in the abstract as by far the most reasonable. By adopting the French system, giving the ½d. as the cent., that placed us on all fours with America, taking the dollar as the unit, and with the French 5 francs, and with the lire, and with many others. That would not change our currency except in the unit of the pound. In Ceylon he fought for a long time in favour of the decimalisation of the rupee. It was carried after five years, and he found that the difficulties which had been anticipated regarding its adoption had been very much overrated, and he had evidence from those who had bitterly opposed it that the change was effected without the slightest difficulty, and that after six weeks people ceased to speak about it. He thought a bugbear of the metric system was the long names and the number of them. But very few of the measurements in the metric system would be adopted in common practice. In the measurement of length the millimètre was the practical standard, which was the 1-32nd (full) part of an inch; then there was the mètre, which was approximately 1 yard—more exactly 1·09. There was also the kilomètre (5-8ths of a mile). The centimètre and the decimètre were seldom used, and practically were only brought in when one wished to express the square or the cube, such as pressure per square centimètre or per square decimètre. In capacity there was the litre, which was ·88 of a quart. The kilolitre was not much used. The gramme was about 1-32nd of an ounce, and the kilogramme 2 1-5th lbs. If the metric system were adopted in England probably the present long names would give place to such terms as the metric ton, the metric acre, or the metric yard, &c. Mention was sometimes made of the difficulty which would be experienced by workmen with the new system. The workmen with whom he had come in contact, who had been in countries where the metric system was adopted, liked it very much, and they did not care to come back afterwards to the English measures. Moreover, under our system workmen used such phrases as "three thirty-seconds of an inch bare" which is wanting in exactitude. On the other hand, with the milimètre there was great accuracy. There was a tendency to over-rate the difficulties of the adoption, compared with the benefits which would accrue to the world generally by a universal system.

People were impatient of a little trouble at present, and were forgetful of the great benefit which would follow. Moreover, if Britain adopted the metric system the United States would quickly follow. The great point was universality. So many nations had adopted the metrical system that England could not expect their system to become the universal one. With regard to sub-division, in countries which used the decimal notation, there was very little division; the practice was to go in for multiplication. In the present days of machinery it was of great importance to be able to calculate by machinery. With the present notation a calculating machine could not be used unless the measures were first converted into decimals.

In reply to a question, SIR GUILFORD said that he helped to have the £ s. d. currency changed for the rupee, and the decimal of the rupee in Ceylon.

Colonel A. CUNNINGHAM thought the discussion an academical one, and that the idea of founding measures of length on a natural unit was a chimera, as it was impossible to measure accurately any unit by any means we knew. Thus we should have to depend upon a unit laid down by law. For enlarged computations the decimal notation was of enormous value, and was the only one which could be practically used; also for such work as in the chemical and electrical industries. But by small traders and the mass of the population the binary division was the one best understood. In France, even much of the calculation by the common people was done in sous and double sous, not by centimes; many measures of weight were done in livres, not in kilogrammes. Thus even in the country of origin the metric system had not been fully adopted by the populace. He spoke of the trade practice in small shops of throwing in an odd article if so many were bought—½d. buns were bought 7 for 3d.; there was the baker's dozen consisting of 13, and both those numbers were very awkward to multiply and divide by. He pointed out several easy aids to memory in regard to weights of quantities of water, &c., and thought Sir Guilford Molesworth had spoken very much from the standpoint of the engineer who dealt in large quantities and with office figures. If a change in currency were to be made, what unit should be adopted? Sir Guilford advocated the halfpenny. Then by decimalising upwards we should fall in with many foreign nations, including the land of the "almighty dollar." But the sovereign was very important, and the question was whether we were to decimalise upwards from a halfpenny, or downwards from a sovereign?

Mr. HAROLD COX pointed out that though the kilo was the official standard in France, the livre was constantly used, especially for dealing in small quantities; so much so that the word "livre" was understood and not put on the ticket. The same applied to the pund in Holland and Denmark, and the pond in Norway, where the half kilo was very often used, and that differed very little from the English pound, which would be a pleasant means of accustoming the British mind to the alteration. This could be called a "metric pound," and one did come across the phrases "metric ton" and "metric cwt." The great point was to have a common international standard; the nomenclature did not matter. For the small transactions of daily life the metric pound, and possibly the metric ounce could possibly be used. It was quite impossible to get a nation to take a large leap from an old to a new system; the path between the two must be bridged for the people.

Mr. J. E. DOWSON, speaking as a member of the Decimal Association, said deputations had waited upon successive Chancellors of the Exchequer—one Liberal, and the other Conservative —but both were equally hard to move. The great obstacle mentioned then, was with regard to coinage—particularly the so-called "poor man's penny." It was feared that the displeasure of the poorer classes might be aroused by lowering the purchasing power of the copper coins. Therefore, the Association thought it wise to confine its attention, for the present, to weights and measures, and this policy had been approved and followed by many Chambers of Commerce, and other public bodies. Though he agreed with the author, it would be better to leave the system of coinage as at present, he did so with this reservation; it would be best to leave the coinage until an Act had been passed rendering compulsory the adoption of the metric weights and measures. After then it will probably be best to decimalise the coinage. He demurred to the author's statement that there had been no progress in the matter during the last 50 years, and pointed to the increasing discussion of the subject in the press and by public bodies. Moreover, the Association now had the signatures of over 290 of the present Members of Parliament in favour of the metric weights and measures. As regards the author's suggestion that we should divide the mètre into 40 "new inches," the speaker pointed out that the late Professor Fitzgerald suggested this identical division in 1896, and that he gave a table, prepared by the professor, in an address to the London Chamber of Commerce on February 25, 1897. He explained that this could not be legalised and enforced, as it was not an exact equivalent of the metric measures. He alluded to the great educational value of the proposed change, and dwelt on the supreme importance of adopting the metric system in our foreign trade relations.

Mr. L. GASTER also spoke on the great advantages of the metric system, and instanced the chemical trade specially. He said the time had gone when England could send out what she liked and invoice in the way she wished. He called attention to the local

variations in the value of such a standard weight as one stone, and concluded with an appeal for the new system.

Mr. JAMES N. SHOOLBRED said the colonial premiers, in their recent conference with the Colonial Secretary, urged strongly the adoption of the metric system, and the London University Convocation sent deputations to the Board of Trade—points of progress which had not been hitherto referred to in the discussion. The metric system did not originate in France, but in England, for James Watt urged it upon the attention of the French *savants* in Paris. The change could not be expected to take place immediately; it must take years, but it would immensely facilitate our trade and other relations with foreign countries.

Mr. R. DUPPA LLOYD took the stand, founded upon Blackstone, that neither Parliament nor any individual had any right to interfere with the weights and measures, and therefore that the subject of such a paper as had been read was not one that could be discussed with advantage.

The CHAIRMAN pointed out that it was an article of the Act of Union between England and Scotland that there should be only one weight and one measure throughout Great Britain.

Mr. R. F. CHISHOLM hoped no alteration would be made without considering the building trade, as the introduction of the metric system would be a great calamity to that industry.

Mr. SONNENSCHEIN said that on account of suffering from deafness he had been unable to follow the arguments. He would, as suggested by the Chairman, send in a written reply after he had seen the report. He quoted De Morgan, 40 years ago, when he said that he believed the decimal division might be introduced very easily, and could exist perfectly well with the binary division, which he was satisfied would always be used by the common people. Mr. Sonnenschein thought the metric system should be introduced into the elementary schools not perfunctorily as it used to be, but that all arithmetic should be based upon it. If that were done other people might take charge of introducing the usage into life. If for two generations of children, a total of 12 years, arithmetic could be taught on the metric system, he felt sure that the metric system would be introduced into the country; it would not be necessary for Parliament to introduce it.

The CHAIRMAN said that apart from the disadvantage of the lateness of the hour, he had a good reason for not entering into the discussion fully that evening, namely that he was to conduct an argument in favour of the metric system against Sir Frederick Bramwell, at the Institution of Electrical Engineers, on the following evening, and, therefore, was not willing to give his case away. The proposal of the author to have a system of our own was very fine, but it was very old, and he quoted against that the report of the committee of 1862. He agreed with Mr. Shoolbred that James Watt called the attention of the French *savant* Laplace to the advantages of the metric system, and the matter was discussed in Paris and introduced by Prince Talleyrand. The Royal Society was invited to nominate members for the Royal Commission, but declined. There were about ten countries who sent delegates, and the committee was absolutely international. The units for discussion were a quadrant of the equator, and a quadrant of the meridian, and the length of a seconds pendulum. After a long deliberation the committee settled on the quadrant of a meridian, *i.e.*, the one ten millionth part of it. The wars delayed the introduction, and Napoleon was against it. In 1812, another system was legalised, and it was not until 1840, that the metric system was established in France. In 1861 a Commission was nominated in Germany, which had the instruction to work out a national system for Germany, but after due deliberation it advocated the metric system, which was eventually introduced. After quoting from various documents, he contended there was overwhelming evidence that the decimal system was the desirable one, and as matters had come about the metric system seemed the only one which should be adopted.

A vote of thanks was heartily accorded to Mr. Sonnenschein for his paper.

Mr. EDWARD JOHNSON (Secretary of the Decimal Association) writes:—As time did not allow of my joining in the discussion last night, I shall feel obliged if you will allow me to correct the very common error into which Colonel Cunningham fell in assuming that the use of the old terms "sou," "pfund," and "livre" proved that the metric system had not been generally accepted by small traders. If he had really investigated the question he would have found that the term "sou" is only a convenient form of denoting 5 centimes, and the "pfund" and "livre" are simply half-kilograms; just as "zentner" is in common use for the half-quintal corresponding nearly with the old "hundredweight" or the "tonne" representing the thousand kilograms. These are simply convenient terms approximately representing the old system, but *actually* representing the metric weights.

Correspondence.

MEANS OF DEFENCE IN THE STRUGGLE FOR LIFE AMONG ANIMALS.

With reference to Professor Poulton's statement which appeared in the *Journal* of Jan. 2nd concerning "insufficiently protected butterflies," I enclose a letter

cut from the *Standard* of October 2nd, 1900, in which some observations of mine are recorded on the subject, and may be of interest :—

"It may interest 'Entomologist' and other lepidopterists to hear that, so far from being rare, the number of *Pieris rapæ*—small whites—in this neighbourhood during September has been practically unlimited. In the middle of the day it has been an easy matter to net six in half an hour; it is noteworthy that the majority of the females have a triangular piece removed from the inner margin of the hind wing—evidently the work of birds. I have seen the sparrows catching some of the small whites and carrying them away in their beaks.

"Red admirals—*i e.*, *Vanessa Atalanta*—have been plentiful here this summer; one specimen measured two and five-eighths of an inch from tip to tip."

C. S. STANFORD WEBSTER.

Redland, Bristol.
Jan. 5th, 1903.

CULTIVATION OF YAMS AND JERUSALEM ARTICHOKES.

In a recent issue of your *Journal*, a writer urges the introduction of yams in order to make up for the partial failure of the potato crop in 1902. I feel that it would be folly to attempt such action. In the first place the yam is a tropical species, and would probably only succeed in exceptionally warm seasons, and be then only a fancy dish for the wealthy. It is true there is a hardy variety, which was introduced from China or Japan about fifty years back, *Dioscorea batatas*, and I well remember planting the same. It was shaped like a club, about 20 inches long, and 4 to 5 inches in circumference at the thickest part, tapering at the top to finger size. This was cut into about eight pieces, and planted in April; soon after, a shoot appeared above ground, like the British *Bryony*, and developed very beautiful marbled heart-shaped foliage, like the Sarsaparilla (6 ft. to 7 ft. long). When this foliage was killed by frost, I proceeded to sample the crop, very carefully working around the bottle-like neck, and a heavy job it proved, for the tubers ran down about three feet into the rock, and were so brittle that several snapped like a carrot, and some yards of soil had to be moved to get out about eight sets. When cooked they proved to be less tasty than a bad waxy potato. It is evident from these facts that *Dioscorea* was useless as a commercial crop, and of doubtful use even after the cook had expended her butter and condiments upon it; either boiled or fried in slices and browned, it was nauseous. I have not tasted other yams in the tropics, or come across South American sorts cooked in England, but if Asparagus is cynically called an excuse for wasting good butter, the *Dioscorea* deserves greater condemnation. No doubt an Indian cook could make any root palatable, but my reason in writing, is to say that as we already have a substitute for potatoes available for the poorest, and not by any means despised by the richest, why waste time, labour, land, and cooking, on a useless tuber. I refer to the Jerusalem artichoke (*Helianthus tuberosus*). In this neglected vegetable we have a tuber that will grow in any soil, requires no attention when once planted; any odd corner is good enough for it, no frost injures it in the soil, and it is most prolific. The small tubers being set in rows, two feet apart, will give good results; and naturally where well-manured light soil is given (as for early potatoes), the tubers are larger and less rugged in outline. In cooking it, the outer skin should be taken off—if with a silver knife, the tubers do not turn black—and they are cooked till soft; served with white sauce, they possess a nutty sweet flavour, and go well with any roast meat, or preferably, they are worth a course to themselves, while in a white soup they are delicious and very digestible. I find them always appreciated. Trusting you will excuse this long note.

GEORGE BUNYARD,
Chairman of the Fruit and Vegetable Committee of the Royal Horticultural Society.

Obituary.

JOHN DUNN-GARDNER. — Mr. Dunn-Gardner, a member of the Society of Arts since 1869, died at his town residence, 37, Grosvenor-place, on Sunday, 11th inst., at the age of 91, having been born on July 20th, 1811. He represented the borough of Bodmin in the House of Commons from 1841 till 1847. He was a collector of old silver and objects of art. His collection was for many years exhibited in the South Kensington Museum, and in the spring of last year it was sold at Messrs. Christie's, the 287 lots realising nearly £40,000.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock :—

JANUARY 28.—"The Cost of Municipal Trading." By DIXON H. DAVIES. The LORD CHIEF JUSTICE, G.C.M.G., will preside.

FEBRUARY 4.—"Methods of Mosaic Construction." By W. L. H. HAMILTON. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I.. will preside.

FEBRUARY 11.—"The Port of London." By Dr. B. W. GINSBURG. ALDERMAN SIR JAMES THOMSON RITCHIE will preside.

FEBRUARY 18.—"Three-Colour Printing." By HARVEY DALZIEL. CARMICHAEL THOMAS will preside.

Indian Section.

Thursday Afternoons, at 4.30 o'clock :—

February 26.—"Gleanings from the Indian Census." By Jervoise Athelstane Baines, C.S.I.

March 12.—"The Currency Policy of India." By J. Barr Robertson. Sir Edward A. Sassoon, Bart., M.P., will preside.

April 23.—"The Province of Sind." By Herbert Mills Birdwood, C.S.I., M.A., LL.D.

May 14.—"The Province of Assam." By Sir Charles James Lyall, K.C.S.I., M.A., LL.D.

Colonial Section.

Tuesday Afternoons, at 4.30 or 5 o'clock :—

February 10, at 5 p.m.—"Women in Canada." By the Countess of Aberdeen. The Rt. Hon. Leonard H. Courtney, M.A., LL.D., will preside.

March 3, at 4.30 p.m.—"The Uganda of To-day." By Herbert Samuel, M.P. Sir Harry H. Johnston, G.C.M.G., K.C.B., will preside.

March 31, at 4.30 p.m.—"British North Borneo." By Henry Walker, Commissioner of Lands, British North Borneo.

May 5, at 4.30 p.m.—"The Lagos Hinterland: its People and its Products." By Major J. H. Ewart.

Applied Art Section.

Tuesdays, at 4.30 or 8 o'clock.

February 3. 4.30 p.m.—"Technical Education in connection with the Book-producing Trades." By Douglas Cockerell. Prof. William Garnett, M.A., D.C.L., will preside.

February 17. 8 p.m.—"Heraldry in Decoration." By George W. Eve, A.R.E. Lewis Foreman Day will preside.

March 17. 4.30 p.m.—"Artistic Fans." By Miss Hannah Falcke. Sir George Birdwood, K.C.I.E., C.S.I., will preside.

May 19. 4.30 p.m.—"The Mounting of a Play" (Stage Costumes and Accessories). By Percy Macquoid, R.I.

Messrs. James Powell and Sons have kindly invited the Applied Art Section to visit the Whitefriars Glass Works, Tudor-street, E.C., on Tuesday evening, April 28th, from 7.30 to 10.30 p.m. A short paper on "Modern Table Glass" will be read by Mr. Harry Powell, and the processes of glass blowing will be explained in the glass house The number of visitors will be limited to 100. Further particulars will be announced later on.

Cantor Lectures.

Monday Evenings, at Eight o'clock :—

Julius Hübner, "Paper Manufacture." Four Lectures.

February 2, 9, 16, 23.

Lecture I.—February 2.—History—Cellulose—Raw materials—Boiling, washing, breaking, and bleaching of rags—Esparto—Straw.

Lecture II.—February 9.—Soda recovery—Manila hemp—Jute and other raw materials—Mechanical wood pulp—Wood cellulose—Beating—Sizing—Loading—Colouring.

Lecture III.—February 16.—Stuff-chest—Regulator — Sand-tables — Strainer — Hand-made paper—Fourdrinier paper machine.

Lecture IV.—February 23.—Single cylinder and other types of paper-making machines—Finishing — Cutting—Statistics—Paper-testing—Experimental paper making.

MEETING FOR THE ENSUING WEEK.

Monday, Jan. 26...Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on Mr. H. T. Scoble's paper, "Rural Drainage and Sewage Disposal."
Geographical, University of London, Burlington-gardens, W., 8½ p.m.
Actuaries, Staples-inn Hall, Holborn, 5½ p.m.
Medical, 11, Chandos-street, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Prof. W. B. Bothamley, "Economic Hope for Ireland."

Tuesday, Jan 27...Royal Institution, Albemarle-street, W., 3 p.m. Professor A. Macfadyen, "The Physiology of Digestion." (Lecture III.)
Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Maurice Fitzmaurice, "The Nile Reservoir, Assuan." 2. Mr. Frederick Wilfrid Scott Stokes, "Sluices and Lock-Gates of the Nile Reservoir, Assuan."
Photographic, 66, Russell-square, W.C., 8 p.m.
Anthropological, 3, Hanover-square, W., 8½ p.m.
Colonial, Northumberland-avenue, W.C., 4½ p.m. Paper on "Indian Forestry."

Wednesday, Jan. 28...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Dixon H. Davies, "The Cost of Municipal Trading."
Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.
British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

Thursday, Jan. 29...Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 6 p.m. Dr. W. Hampson, "Liquid Air."
Royal Institution, Albemarle-street, W., 3 p.m. Dr. A. J. Evans. "Pre-Phœnician Writing in Crete, and its Bearings on the History of the Alphabet." (Lecture III.)

Friday, Jan. 30...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. W. E. Dalby, "Vibration Problems in Engineering Science."
Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. J. R. MacIntosh, "The Design of the Electrical Equipment of a Light Railway."
Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m., Paper on "Pavements."

Saturday, Jan. 31...Royal Institution, Albemarle-street, W., 3 p.m. Sir Frederick Bridge, "The Bi-Centenary of Samuel Pepys: His Musical Contemporaries, Criticisms, and Compositions." (Lecture III.)

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FRIDAY, JANUARY 30, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, February 2, 8 p.m. (Cantor Lectures.) Julius Hübner, "Paper Manufacture." (Lecture I.)

Tuesday, February 3, 4.30 p.m. (Applied Art Section.) Douglas Cockerell, "Technical Education in connection with the Book-producing Trades."

Wednesday, February 4, 8 p.m. (Ordinary Meeting.) W. H. L. Hamilton, "Methods of Mosaic Construction."

Friday, February 6, 8 p.m. Adjourned Discussion on Mr. Dixon Davies's paper on "The Cost of Municipal Trading." The Lord Chief Justice in the chair.

Further details of the Society's Meetings will be found at the end of this number.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, January 20, 1903, 8 p.m.; Lewis Foreman Day, Vice-President of the Society, in the chair.

The paper read was—

SOME PRINCIPLES THAT MAY BE GUIDES FOR THE APPLIED ARTS.

By G. F. Bodley, R.A.

Asked to lecture here to-night, I have set myself, I fear, a somewhat difficult task in speaking to you of some of the principles that rule, or should rule, what are called the "applied arts." It were easy to cite examples of the arts—to describe the great works of the past, to catalogue the achievements that the mind of man has conceived and his hand has wrought. It were easy, I mean, to bring facts before you. It is not so easy to tell of ideals and principles that should guide, and should enlighten the mind of the designer or the doer. Yet all art is a thing to be sought after and to be learnt, and it must needs have its principles. Nevertheless, in some sort art is instinctive, spontaneous, and its happiest achievements are those that spring free, sudden, uninvited, the happy inspiration of the moment. It is not for all thus to conceive or thus to achieve. Rules are best for most of us.

Well, I am to speak to-night of some of the principles that may lead us into, and guide us along, the delightful paths of creative art—creative, for art is nothing if not creative. Are there any such principles? Is art only an inspiration? Or is it only imitative? It cannot be merely an inspiration, for it is certainly learnt, fostered, and nurtured and developed by laborious thought of the mind and by the patient labour of the hand, and by the traditions of the ages. It cannot be only imitative, for where, then comes in the Creative faculty? An inspiration may plant a seed; but the seedling will not reach perfection, untended and uncultivated.

Here then comes in the use of principles to direct the growth into right ways, to prune, to educe the good, and to root up and reject the bad.

This use, this carrying out, of principles in design, is not, indeed, the most poetical, or the most interesting department of the teaching of art,—far from it. It is rather the prose and the common-sense aspect of its initiative. It is very different to that "light that was never was on sea or land," it is different to the glad surprise of the joyous thought of an artist's mind, the grand, or the beautiful conception, innate with the added creative power of the hand eager to achieve. Rules and laws are but as schoolmasters, and have a manner of restraining and curbing.

But to go back to what I have said, are there any principles that may guide us along the path of art? I think there are. First and foremost, there is the principle of following Nature—Nature in her stately grandeur or in her calm beauty—Nature from the "human form divine" to the simplest flower or delicate, tiny shell; from the mighty mountain, to the tender grass of the valley. In the highest arts, as in sculpture and painting, there is the obvious principle

of closely and faithfully following Nature, not indeed without selection and judgment and feeling, and not, above all, without Imagination. For we must touch all our art work with human feeling and human thought. Nevertheless, the everlasting law for the arts of painting and sculpture is to be in complete harmony with Nature, at her best, and to be faithful and true to her teaching. We know the superlative, the astonishing truthfulness of Greek sculpture; how each fragment found, if it be part of a nude statue, for example, is as delicately modelled as the living flesh and the skin-clothed muscles were,—how drapery seems as if it were the very petrifaction of the light, delicate folds of the thin linen that draped the figure. I know not what is most remarkable about Greek sculpture, its beauty or its glad following of nature. This then I would put as the primary rule and principle for all art,—the following of Nature; and that not only in the forms and shapes of natural objects, but in giving to all things we make the very spirit of nature. What lessons of delicate curve and strength and delicate modelling, do we not find in the human figure? Sir Joshua Reynolds wrote: "It seems to me that there is but one presiding principle, which regulates and gives stability to every art. The works, whether of the Poets, Painters, Moralists, or Historians, which are built upon general Nature, live for ever."

And this brings me to the next principle that I would mention, one indeed closely allied to that of truth to Nature. It is this,—to endow everything we make with the expression of Life,—to give to all our hand-made productions, be they but the common utensils of daily life, be they but pots or pans, or be they Crowns for Kings and Queens, the expression of life. In all the great days of art there was that expression (which, indeed, has a sort of divinity in it) given in all things made. You find it in Greek work; you find it in the work of the middle age, in all the civilized countries, when art was healthy and was growing gradually into the astonishing beauty that was produced in the great days of matured art. Everything, after its kind, was made, some more, some less, with an expression of Life. In their nervous, graceful, or vigorous curves, in their kindly expression there was life. As you well know many flowers have an expression, some of the most pleasing nature. They smile at you. Well, in the same way the workers in gold, or in silver, or other metal, or in China, or pottery, gave an expression of life to the things they made, though the thing made had no exact resemblance in form to any natural object.

The thing, be it of the commonest type, be it your ink-pot, your chair or your table, or wine glass, or be it a jewelled cross, or a silver heart for a Lady to wear on her breast; be it a sceptre for a King, or a drinking cup for a child, one and all had, in the best days of art, an expression, nay, as it were, an endowment of life. The hand and the mind of man, their maker, had so endowed them. No doubt it may require some imagination to see this, and some good things may have it but slightly, and some more, some less.

But now look at modern things of the kind I mean. Except some few made under better auspices, they are dead as the clay or the gold out of which they were made. In the one there is the beautiful curve, full of energy, or it may be of repose, or it is generous of a pleasing and a kindly expression. The other is dull, nay dead, without expression, except indeed it be one of inane ugliness; and even that would seem to have come by chance, so much inanity there is in it. In the one the mind of a man, who loved and enjoyed his work, is reflected. In the other there is none of this. It is vacant, lifeless, hopeless. When you are at a Museum of good old art objects look at them and compare them with nearly all modern manufactures. If you have artistic perceptions you will readily see what I mean. And it is *this* that I mean,—the mind, not alone the hand of its maker, has endowed the object with an expression; and following, in all reverence be it spoken, the Divine law of Creation, he has breathed into it the spirit of life. Where this is done, we have, so far, a work of art. If it is not done, it is poor stuff at best. And it is not the richness, or the poverty, of the thing that brings this to pass; for the simplest object may have the expression of life, and, indeed, of beauty; and the richest may be wholly without it.

The late Lord Leighton used to have a small Greek lamp on the mantelshelf in his Studio. It was utterly simple in its lines, and without what you would call ornament, but it was not only beautifully designed, it was, to my eye, instinct with the expression of life. I have said that nature was our guide: well, chairs and lamps, and the proverbial pot and pans, cannot be made like any natural object, or, if so made, they would be wrong, utterly wrong. But they, and all things, can, in different degrees, and

in different manners, symbolize life. Is it not this expression of Life that makes conventional ornament not only bearable, but pleasant in its place and after its manner? You know how, in every style and manner of architectural art, conventional ornament has played a conspicuous, an important, nay, I may say, a delightful part. Well, why is this conventional ornament not only to be tolerated, but to be a real pleasure? I think, nay I am sure, it is because in all good, intelligently designed conventional ornament there is an expression of Life. It is this that gives the soul to Art. Beautiful, beyond compare, are the forms of flowers, of leaves, of trees, of the very grass of the field. But more beautiful is their expression of expanding life, whispering, perhaps, and moving to the gentle air. And this expression you can give to the work of hand-made things—manufactures as we call them. I have mentioned the old testimony of the Creation, "He breathed into them the breath of life." And man, "whose breath is in his nostrils," so frail and passing, with so brief a life, can, if he will, endow his own handiwork, his own creation, with the very semblance of life. It is this that makes the lesser arts noble. And would not this and other principles raise manufactures that are made by the hand of man, directed by his mind, would they not take us, I would ask, into the region of Art? I do not mean into the region of high or fine art. Things may be made, and are made, by machinery, helped by the hand of man, without help from his mind. There is no art in such things, only ingenuity. Others may be made by machinery too, but directed by the mind of man. I mean such things as woven tapestries and carpets, and other textile fabrics, and they come into the region of Art. As we say of some things, "it is quite a work of art." We may truly say so of the best kinds of Eastern carpets, so beautifully made, and so beautiful in their colouring.

Have you ever observed how the *mind* of a weaver of these Oriental carpets works with his hand? For example, when an orange-tinted wool comes against a red, it pales to a more golden hue; when it comes against a blue it will warm or deepen again. The orange against the red would have been hot and unpleasant-looking. Alas! that these Eastern manufactures are so fast degenerating. Indeed, some kinds, or "makes," of carpets that have been beautiful for many centuries (we know some portrayed in the accurate pictures of a Van Eyck or a Memling) have, I am told, recently ceased to be made at all. I hope that Lord Curzon's good work in trying to maintain Indian manufactures may be of use. Not that much Indian furniture is really satisfactory in design. But the carpets and many other textile fabrics are beyond praise. They are delightful; and teach us how colour should be treated in manufactures. They are works of art most certainly. It is true that fine art takes us into a higher region and to a nobler ideal. But here at this "Section of the Applied Arts," we are, I suppose, on somewhat lower, perhaps more useful, ground. But even in the weaving of carpets—in their palpitation of colour there may be this expression of life as well as in the drawing of their foliage or other ornament.

Another principle is that all our work should be Beautiful. Would that we lived with beauty all around us, and had not the deteriorating influence of ugly things that crowd around us in their imbecility! How depressing are all ugly things! How delightful, how elevating, is the influence of a thing that is, in its beauty, "a joy for ever"—a thing that becomes almost a friend and a companion. And why? Because it mirrors the mind of a man who has striven to give it an expression, innate with beauty. I should like a crusade preached against the profanity of ugliness, and to see ugly things publicly burnt in one of our great, rich, London Squares! I suspect many ugly things would not have to be carried very far to feed the bonfire! Well! taste is growing,—let it grow! I have used the phrase "profanity of ugliness." "In the beginning," all things made were pronounced to be "good." I think, therefore, my word "profanity" is not wholly unjustifiable! One could not call the ugly things I mean "good."

Another principle of art that I would mention is that of breadth of effect. It applies largely to artistic manufactures, or manufactures that might be artistic. Now I cannot but think that in all art one thing greatly lacking, in these days, is this grand quality of breadth of effect. I venture to think so of much modern painting, whether of pictures or decorative work. In all the arts breadth of effect is a great quality. Here again look at Nature. The low lying land and the grassy hills, are they not broad in colour, in their vast expanse of green? Varied and gradated green, no doubt, as all nature's colouring is gradated, but, broadly, green. And the sky, is not its great dome at times all blue—gradated, indeed, again, to a silvery tint, where it touches the dark green land? And the clouds, are they not at times

all tints of grey, and at times all that beautiful colour of solemn, subdued purple that we call inky, that is so beautiful against the green of the hill or of the trees? I am not forgetting the sunrise or the sunset; but those are but moments of exceptional beauty that linger but for a little while. And the green of the land may be sprinkled with flowers, but they are but as jewels on a robe of one tint.

The more subordinate the nature of decorative work may be the more broad it should be in its treatment. For example, mosaic work for a vaulting or a wall is quite the best if it has but few colours. You may have a gold background, and your figures may be—one all in shades of reds, another all in shades of blues or greens; or a purple robe may be lined with green—colours that have a delightful affinity, and the result will be broad and satisfying. So in marble work. Black and white, red and white, green and white—only those two colours together—will be more dignified than if other tints are intermingled, to the loss of breadth of effect. What is it that makes the difference between many new buildings and good old examples of architecture? It is not the charm of age, for that chiefly affects the colour. Is it not that the old work has a noble breadth of effect and a unity of idea, restraint, and an avoidance of all discordant elements? While of much modern work must we not say that vulgar confusion, and useless variety and display, take the place of sauvity of manner and a dignified and noble breadth of effect? For there is in old buildings a nice economy, not only of material, but of ornament, and there is a satisfying charm about most of them, of almost any period. The old architecture had stately manners. Too many of our new buildings have pretentious ways. I think it is from the lack of the principle of refinement and especially of a delightful breadth of effect that many things suffer now-a-days. It is a principle that extends to Literature. Unity of idea is a mark of a great poem, or, indeed, of all good literature. But I am trespassing on to other land.

We live at a time in which there is a considerable feeling after a better and more beautiful treatment of designs for new buildings in our streets. They are certainly becoming more ornate, and more pains is being taken to make them more interesting than in days when the long unlovely streets, like Harley-street or Winpole-street were built. What seems missing in many, if not most, of these new street fronts is a sense of greater dignity and restraint of character; more refinement and more breadth of effect. In one word, a higher conception and a more refined and broad, and a more reasonable carrying out of such conception. The great principle I have spoken of, Refinement, is too often absent. Indeed, too many new buildings cannot but be designated as pretentious and vulgar, instead of being dignified and refined. It is a critical time for architecture. I hope we may see better work done, more thorough in the expression of the principles of truth and of a stately beauty, both in the humblest and the noblest buildings.

Another principle is that of Delicacy. Look at the infinite delicacy of leaves and grass and flowers, and their infinite refinement of form and texture and of colour—the gentle gradations, the melting of one colour into another,—so subtle, so delicate! Look at the passing cloud-shadow on the bare dawn, so gentle, so transparent. Look at the sea, with its purple and green and its soft-toned white, full of *gentle* shadow, slowly moving in the delicate curve of a cresting wave. In all Nature there is delicacy, and in all art, of the finest kind, delicacy has ever been a great principle. Compare modern jewellery with new. It is the delicacy of the one, and the coarseness of the other, that makes old jewellery delightful, and most of the modern contemptible. But I must pass on, though I could say much more on this point.

And now one word about colour. I can only briefly touch on this. It is a large subject, and colour is a thing so subtle, so delicate, so strange in its ways that it seems to be beyond rules and laws. For example, you may place one red against another,—a crimson, laky red against an orange red, in other words, you may mingle your different reds together and always with happy result. Who has not seen the peasant children in Italy, in the shaded slums of the old town it may be, or in the country under the bright sunlight. Their dresses are frequently—most frequently—reds of very different tints, scarlet and crimsons, and all harmonise. In pictures by the Old Masters you will find one figure in robes of one red, and side by side with it another in a robe of a totally different hue of the same colour; all is harmonious Now try to do the same with different greens. You cannot. A warm, fruity green, beautiful in itself, will not harmonise with a cold silvery green, though that too may be beautiful — most beautiful—in itself. I am speaking of decorative painting. Why is this? I can find no

reason except that colour is so delicate a thing that it is allowed to be free from laws—to be beyond rule, so that I am reminded of a volume of travel in which one of the chapters is headed "The Snakes in Iceland." You turn to the chapter, and all that is said about the subject is "There are no snakes in Iceland": and so with the laws and principles for colour. Indeed I think there are none. Nevertheless, the eye can be trained, and the taste can be cultivated to love the beautiful in colour, as in form. For everything is there the law to be beautiful.

Another principal, or should I say a desirable, practice, is that of founding work on what has gone before. It is at times a charge made by somewhat shallow thinkers, if I may say so, that all work must be entirely original and absolutely new. Sir Joshua Reynolds did not think so of works of painting. He said the best work that had been done in the long history of painting was founded on the work that had been already achieved. He says that such work will be the "most *original*, though it seems like a paradox to say so."

It is, indeed, but reasonable in the different departments of the arts—it is but natural, to found your work on that of the Past. You have a thing to do; you have to design for a certain object. Well, you build, as it were, on the foundations of the past. But you see how this or that can be improved on, refined on, or strengthened. You see it with the eyes of your own mind, and conceive it afresh with your own imagination. You develop the original idea; you depart from it; or you give it a new character—a new clothing. In one word, you make it your own. Has not this been so in all the arts? Is it not thus that art hands on its Spirit which is immortal? If I were speaking to students of art, I should say, "fear not to found your work on that of the past ages." Catch the spirit of beautiful work already achieved, and, as it were, grasp the torch from the hand, the doer of work in the past, and throw a newly-directed light with it—a light to fall on a new parting of the ways—ways that may lead to higher heights yet attained, and to pastures new. That is the way to utilise old traditions. You need not ignore them. Do not so; but use them as stepping stones to still higher and nobler imaginings.

I could say much more of the guiding principles for art. I could tell you of the principle of Strength, not only of strength of construction, but of strength of artistic expression. I could tell you of Delicacy without weakness, and of Power without coarseness. Of Truth (and, indeed, that should have had the first place) I could tell you of Harmony and of the avoidance of all harsh and violent contrasts. I could tell you how the nature of the materials we use often controls the very first idea of a design; and of other characteristics leading to good and artistic work. But I should weary you. Indeed, I fear I have already done so. One word more, and it is this, while such principles as I have feebly touched on are, and should be, as it were, the bye-laws of art production, yet, in all the arts, a healthy, well-informed, and well-cultivated Imagination is beyond and above all rules.

DISCUSSION.

The CHAIRMAN, in inviting discussion, said that Mr. Bodley had given them a lofty discourse upon a noble subject. Probably the opinion of the greater number of those present would be very much in unison with what he had said; but they would like to hear the opinion of those present.

Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., said it would be the greatest presumption on his part to attempt to discuss the views advanced by Mr. Bodley, in so masterful a manner, on the technical questions dealt with in the paper with which he had appropriately and brilliantly opened the current session of the Applied Art Section of the Society of Arts. But he gladly availed himself of the opportunity given him of addressing the meeting, to express, on behalf of the Applied Art Section, his sense of deep obligation to Mr. Bodley, for a "discourse of reason" stamped with his high authority as an architect, and to which he had listened also with the greatest pleasure and delight, for its rare literary elevation and refinement. He felt that it would be too presumptuous for him even to express his agreement with the views so ably supported by Mr. Bodley, but he could not help saying that he had always been on the side of those who followed tradition in the arts, and that it was most cheering to him to find Mr. Bodley as impressive and convincing an exponent of these traditions in controversy as in his professional practice. For his own part he judged of an object being artistically good or bad by the emotion it caused in him. If the sight of it gave him peace—a devout feeling of peace and goodwill—he knew it was superlatively good, and beyond criticism. If he was filled with a downright murderous desire to destroy the object—say the new "Admiralty"—he knew that it was "beastly bad," and to be blotted out of mind without further consideration Reflective, and more or less constructive criticism came in when looking at objects which were, on the hypothesis, good, but im-

perfectly good. A fair face appears before you, and, instantaneously with its appearance, you feel that there is needing some little remodelling of the eyebrows, or nose, or ears, &c., to make it perfectly beautiful. Again, one of the grandest of architectural prospects was that presented by the northern end of the Houses of Parliament, and of Westminster Hall, and the northern side of St. Margaret's Church, and of Westminster Abbey, as viewed from the spot where Rorke the picture-frame shop (now in Jermyn-street, W.) once stood; or from the south upper windows of St. Stephen's Club; that is the whole continuous prospect from the river Thames at Westminster Bridge to the vista down Victoria-street. Whether seen in the silvery mists of winter mornings, or the glowing haze of summer evenings, there is nothing like it in the architecture of all Europe for stately splendour, and imposing picturesqueness. But always along the length of that wonderfully picturesque sky line one thing is felt to be wanting, and that is the centre spire which has never yet been placed over the Abbey. Without knowing that it was ever intended to be there, one feels it wanting. He spoke as an ignoramus, but he presumed that it was in feelings of this sort, that is, in one's artistic content, or discontent, that art criticism—reflections and judgments on artistic objects—was ultimately founded. But is not the principle involved merely the satisfaction, or dissatisfaction, of one's own and individual taste, —or idiosyncracy? Even where masses of educated people are moved exactly in the same way by artistic objects, is that any indication of universal law, or of principles to be observed in their "creation"? He was not entitled to give an answer to the question, but he certainly was a humble follower of those who gave Mr. Bodley's answer to it. He had derived the greatest satisfaction from the emphatic contempt which Mr. Bodley had so epigrammatically expressed for those artists, particularly in the applied arts, who were always striving after "originality." There could not possibly be any originality in human art, until some original species of men was created; and they would not be human. The only possible originality in the arts was in their perfection; that is in the utmost development of each artist's own individuality, by patient, and sincere, and thorough workmanship; that is through the universal law of our intellectual and moral nature, "perfection through suffering." He had been particularly interested by what Mr. Bodley had said of the impossibility of defining the law of colour. In India the weavers of women's robes, and, again, of rugs and carpets, if asked how they brought out their perfect harmonies of colours, replied in the vernacular phrase:—"*jisa ata isa ata;*" which might be translated at large:—"we let them occur." And in fact, these weavers, when starting on a carpet, never first collected the whole quantity of coloured threads wanted, but sent for supply after supply as demanded for the work. Very rarely is the fresh supply of any thread, red, yellow, or blue, &c., of the same shade as that it follows up: and if, after working it in for a while it is found to disturb the harmony of the colours, *i.e.*, the weavers artistic content, it is snapped off, and another supply of the colour is sent for. Thus these Indian weavers feel their way to those magical harmonies, which defy all the laws of colour recognised in Europe. Moreover these repeated breaks in the shades, hues, or tints of the colours used by them, produce that play of light and shade to be observed in all Oriental carpets, of genuine native manufacture, so greatly to the enhancement of their artistic effect. In fact, the eye for colour is a divine gift; and its power as soothing the soul, which passes all understanding (and is felt more and more the older we grow, and our vision for form becomes dimmed), has been well said to be the origin of the healing powers attributed by all antiquity, and still throughout the East, to the precious stones. As to the influence of prejudice on artistic emotion and judgment, it is quite incalculable. Many years ago, he bought a pot of Narbonne honey, then just received from Arles. He bought it for the pot, although the fact that it contained honey, no doubt, also charmed him; and beyond the simplicity of its œnochœic form, and scroll of decoration, traced lightly round about it, the fascination of it was that it had come from Arles; and that, although a stoneware pot of to-day, and suggested by the rising fame of the Doulton pottery of Lambeth, its Greek grace of form, and reticence of decoration, were obviously due to the continuity of the tradition of Massalian Art in the South of France, as at Cette (*i.e.*, Seta—the Sanskrit *sita*—compare Sita, wife of Rama—and referring to its having been an emporium of the export corn of Gallia). On the very first lecture on pottery subsequently held here, and delivered by himself, he produced this "twopenny-half-penny" pot, and triumphantly contrasted its classical simplicity with the over elaboration of much of the artistic Doulton ware of the period. There was a hearty round of applause;—when casually turning the pot over he for the first time noticed, and at once brought to the notice of the meeting, that it was stamped on the bottom with the now wide-world known Doulton trade mark; the sight of which raised a hearty laugh, and this time against himself, and not Mr. (afterwards Sir Henry) Doulton, who was all the time seated in front of him with a twinkle in his benevolent eyes, as of one assured of the inevitable *dénouement*. He was now prouder than ever of that pot. Sir George added that he was glad to give this true account of the incident in correction of a false version of it in circulation evidently concocted of "miching mallecho" to discredit the expert staff of the South Kensington (Victoria and Albert) Museum.

Mr. A. F. Brophy, alluding to Sir George Birdwood's statement as to the Indian carpet weavers allowing the colours to "occur," said that he also could tell a story on that point. A lady up the River Thames had a house-boat, and she also had five

beautiful blue vases. It puzzled her very much to decide how she could arrange them artistically. She consulted an artistic oracle, who said, "Do not arrange them. Let them occur."

Mr. G. C. HAITÉ said that he agreed with his friend, Mr. Brophy's view, that it was better not to try to arrange these vases if one did not know how to arrange them. He held that not only must all art, whether fine or applied, have fixed, determined, and definite principles, but so must every fine example of art, whether it be fine art or applied art. It was true that in some cases the principles had been found and had been expressed by that divine instinct which we called "genius," but that was possessed by few. He could not imagine anything of greater or graver importance at the present moment, not only as an educational factor in arts, but as an educational factor in relation to national interests and the position which England was to take later on. He was not altogether in accord with all that Mr. Bodley had said, but he thought it extremely likely that Mr. Bodley and he might agree even where he ventured to differ from Mr. Bodley, inasmuch as they were doubtless using the different terms to express the same meaning. He had been interested to find how, with the best motives possible, and with the greatest desire to be as broad as they could, the best of them treated this most important subject from the position of a bias. Mr. Bodley had taught him by his paper that he (Mr. Haité) had doubtless treated the subject from the position of the bias of the decorator; and he felt equally sure that Mr. Bodley had treated it with the natural bias of an architect. He gathered that the subject of the evening applied to the question of the principles which belonged to applied art in contradistinction to so-called fine art. He had an absolute conviction that there was only one principle, and that the other so-called principles were really laws which were used of necessity for giving expression to the principle itself. He had therefore come to the conclusion that the first and great principle of art was fitness, and that the laws which gave expression to that great principle were amongst those which Mr. Bodley had enumerated as principles. The paper spoke of the third principle of art as delicacy and refinement. He (Mr. Haité) and his colleague, Mr. Hamilton Jackson, had ventured to define it as simplicity. Mr. Bodley had referred to the fourth principle as breadth of effect. He (Mr. Haité) and Mr. Hamilton Jackson had condensed it into the term "subordination." But there was no doubt that they were all in accord, even on the point where he thought that they might differ, and that of the necessity for the observance of principles. He thought that a subject of such great importance as the present should be thoroughly discussed in Council by men like Mr. Bodley and others whom he could name, and that the arguments could be advanced there under better circumstances than at a meeting like the present. He recognised the principle of beauty, and he had always deprecated the fashion of the worship of the ugly. He hoped that they would see nothing more of it. The author had referred to the necessity of imitating nature, and he had mentioned the word "convention." Art should be true to nature, and conventionalism was, to his mind, only the emphasising of the characteristics and structure of nature. The author had declared certain art or art expression to be high or base, but he (Mr. Haité) thought that there might be a middle course. The middle course was at least unsuitable. That which was unsuitable was likely to become base. He was glad to hear Mr. Bodley's remarks on the question of weaving. The remarks on colour opened up a stupendous and extremely difficult subject. To speak of red meant absolutely nothing, because there were millions of red. There was, and there must be until science did something more for them, an irrevocable law applying to colour. He was speaking of pigmentic colour in contradistinction to prismatic colour. There were three pigments from which they could get all colours; and they were red, yellow, and blue. Prismatic colour was another thing altogether. The scientific mixture of the three colours which he had named gave the secondaries and the tertiaries. If they went on and mixed the tertiaries they got mud. That was the only pigmentic law of colour. To teach fine colour was impossible. It was born in a man, and it was possibly the rarest gift which mortal had. The author had used a very beautiful sentence which he should like to see written up permanently in some such lecture hall as this. He had advised the students to "grasp the spirit of the beautiful works already achieved." Those words should be made so familiar that every student should not only know them but always seek to apply them. In reference to Sir George Birdwood's remarks, he should like to point out that in allowing his instincts to settle what was right and what was wrong, he was giving his instincts the preference to his judgment, and in doing so he was exercising no necessarily artistic sense, but a personal idiosyncrasy. He was prepared to admit that, in Sir George Birdwood's case, nature had been extremely kind and that he had been rarely gifted; but to allow instinct to take the place of judgment would be a very dangerous principle to advance.

Mr. P. H. NEWMAN said that Mr. Bodley was a past master in architecture, and naturally he must know a great deal about decorative art. It was a consolation to him that the personal element to which the last speaker had alluded must come in. It would be a gratification to every artist in the room that things were "harking back" a little, and that artists were going back to first principles. It was a perfectly delightful thing to hear a man of the influence of Mr. Bodley saying what he had said about the foundations of art. It was satisfactory to know that at the present day England was halting, not with any idea of stopping, but with the idea of taking breath for greater advances in the recognition of the

artistic faculty. It was a regrettable thing that decorative art in this country, like many other arts, had failed from the simple want of the recognition of the great principles of art which Mr. Bodley had harked back upon, and which ought to be inscribed in letters of gold. Mr. Bodley could not tell them anything new for there was noth'ng new to tell, except so far as that which was old and reliable was ever new and ever fresh; and from this the younger artists as they arose should draw their first and last principles. Sir George Birdwood had remarked most admirably upon that beautiful group of buildings at Westminster, and had pointed out something which, according to his mind, was missing—the central spire which was never built on Westminster Abbey. He was sure that Sir George Birdwood would forgive him if he said that it would be a most painful thing to Sir George to find that there was nothing more left to be desired, because, as Sir George knew, that would be intellectual death. The desire for something which the individual in his idiosyncrasy added where the artist had left off was a source of enjoyment not only in decorative art and in painting but also in the other fine arts. It was the something which was suggested but never came except in the mind of the viewer. He hardly liked to touch upon the subject of colour, though it was very dear to him, and he was glad to hear Mr. Bodley speak of those reds, but he was so disappointed to hear him speak of the greens. There were principles underlying these things, and he felt sure that Mr. Bodley could harmonise the grey-green with the deeper one if he would only have a little yellow by the side of it.

The CHAIRMAN proposed a vote of thanks to Mr. Bodley for his charming paper. It was too much the custom to deny that there were such things as principles at all. The principles which Mr. Bodley had laid down—life, delicacy, breadth, refinement, truth, and adherence to tradition, were, they would all agree, at all events, leading strings. He had been thinking of the principles of Owen Jones, and he had thought that his principles were only a sort of working rules. In anticipation of Mr. Bodley's paper he had tried himself to think what were the principles which should govern applied art. He had thought of Owen Jones, but his principles turned out to be only working rules. He had thought of Ruskin and his seven lamps, but they shed only a flickering and rather fantastic light upon the question. He was bound to confess he had not thougt of life as the great principle. He entirely agreed with Mr. Bodley that that principle was one to be dwelt upon. He had been glad to hear him say a word for the conventional, and especially to hear him advise artists not to fear to found their work upon the past. That was a word which wanted saying very much just now, and Mr. Bodley had said it with the authority of knowledge and conviction. Conviction was that which impressed and interested us, whether we agreed with the speaker or not, and there could be no doubt of the entire sincerity of every word Mr. Bodley had said. He had been surprised to find such unanimity in agreeing with Mr. Bodley, but he had observed that those who had agreed with him were like himself (the Chairman) either grey or bald. There were many young men in the room who, if they had spoken, would have spoken differently, but they had abstained from doing so, and he admired their modesty. Referring to the case mentioned by Sir George Birdwood of the man who let his colours "occur," there seemed in it to be implied the notion that there was no law. To him that idea was heresy, and baneful heresy too. They all admitted that an artist acted on instinct, but an artist was by rights so penetrated by principles and laws that those principles and laws became part of him, and when an impulse or an inspiration came, the habit which he had acquired led him to act according to law, and so, even in his inspiration he unknowingly obeyed the law. Personally, he (the Chairman) was a little disappointed that Mr. Bodley had kept so entirely to the poetic side of the subject, delightful as it was. He should have liked to hear a little more stress laid upon the practical side of a design to which, in applied art at all events, the poetry had to be adapted. Principle must guide every artist who did anything. Personally, he was inclined to think that it did not much matter what the principle was. The essential thing was that the artist should have some faith, and that he should have the courage of it and be stedfast in it. If that was the case, the artist would be pretty sure to work out his own salvation. But some principle must underlie all good work—and that was the doctrine which Mr. Bodley had preached. He was sure that they had all listened with the greatest pleasure to the paper, and he proposed a hearty vote of thanks to the author. This was carried unanimously.

Mr. G. F. BODLEY said that he was very much obliged for the kind expressions of the Chairman, and for the way in which they had been received by the audience. Replying to the discussion, he said that colour had been alluded to as expressed by known laws. They might remember a book written by the painter, Sir George Beaumont; the author who told people that there must be a brown tree in every landscape, and he told them where to put the tree; and he went on to say, "Never let green come near blue." As if the green trees and green hills never stood out against the blue sky! That, he believed, was an old "academic law!" but it was, of course, contrary to the teaching of Nature. The vexed question of following old work, as against inventing new, had been discussed. It always seemed to him that to try to invent a new style of architecture was silly. Architectural style was only a sort of language. Suppose a second Shakespeare or a second Milton was to arise to-morrow, with his mind full of ideas. Would the first thing that he would do be to

invent a new language? What mattered the language? The thing that mattered was what the man had to say. But he could assure them that there was a large school of young architects who laughed at a man using the old, beautiful, established language of architecture, whether classical or Gothic; and that school not only tried to invent a new style, but they refused to look at anything unless it was absolutely new. If he had learnt anything of the history of art at all, it was that everything had been built up, generation after generation, by tradition. That fact had been pointed out by Sir Joshua Reynolds, as he had said in his paper. The question to be asked about any design is not "is it new," but is it fitting,—is it beautiful?

EIGHTH ORDINARY MEETING.

Wednesday, January 28, 1903; the LORD CHIEF JUSTICE, G.C.M.G., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Bland, George, North-park-road, Harrogate.
Devenish, J. A., care of Messrs. King, King and Co., Bombay, India.
Dickie, Archibald Campbell, A.R.I.B.A., 21, Bedford-row, W.C.
Goodspeed, Prof. Arthur Willis, Ph.D., University of Pennsylvania, Philadelphia, U.S.A.
Hamilton, Hamilton, 138, Fremont-street, Peekskill, New York, U.S.A.
Laidlaw, John, 24, Park-circus, Glasgow.

The following candidates were balloted for and duly elected members of the Society: —

Barnes, Warren D., care of Messrs. H. S. King and Co., 45, Pall-mall, S.W.
Berrington, Evelyn D., The Ayrshire Mine, Lomagunda, Mashonaland, South Africa.
Bharoocha, Sohrab Framjee, Shamjee - building, Sleater-road, Bombay.
Bradshaw, Vincent Edward Patrick, Resident Magistrate, Taung, Bechuanaland, South Africa.
Cowasji, Hormusji, Aden.
Cobban, Alexander McDonald, Scunthorpe Urban District Council, Scunthorpe, Doncaster.
Crichton, Lionel A., 18, Hamilton-terrace, N.W.
Damon, Samuel Mills, Honolulu, Hawaii.
Dawson, John Eugène, Freetown, Sierra Leone, West Africa.
Eames, James Bromley, M.A., B.C.L., 1, King's-bench-walk, Temple, E.C.
Evered, John E., 99, Cannon-street, E.C.
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The paper read was—

THE COST OF MUNICIPAL TRADING.

BY DIXON H. DAVIES.

SYNOPSIS.

The Growth of Local Debt and Rates — Taxation without Representation—The Overriding of the Common Law—Self-interest the moving spirit Demoralising to the Voter, Stimulating to the trader—The Stifling of trade—Financial commitments and expedients—Sinking Funds and Profits—Unreasoning optimism—Cant of Collectivism — The Effect on National and Civic character—Supposed advantages: (1) Cheap borrowing; (2) The City for the Citizen; (3 Better than Company Direction; (4) Regard for consumers; (5) An Escape from Trusts; (6) Superior control—Suggested Remedies.

Four years ago the Society of Arts took the initiative in raising the question of the propriety of the modern departure of our local administration from the British principle that Governments should not be concerned in trade. The Society petitioned the Government for an inquiry, and the Joint Committee of the two Houses of Parliament sat throughout one Session, and published a large Blue-book of evidence, though, for some reason which is not very clear, they have been deprived of the opportunity of reporting their conclusions. The *Times* newspaper has continued the inquiry (thus affording another example of the superiority of private to governmental enterprise) and has published the results of a most elaborate investigation into the whole subject in a long series of highly informing articles. The Royal Statistical Society has added to the controversy a notable paper by its late President, the Right Hon. Sir Henry Fowler. Numerous other papers and writers have continued the discussion, and there is now a prospect that the Parliamentary inquiry will be re-opened.

The Growth of Local Debt and Rates.

The subject has grown not only in public prominence, but also in the magnitude of its operations during these four years, but, so belated are the returns of the Local Government Board, it is not possible to give statistics which are less than three years in arrear. Making the best of the available materials it may be said that the local indebtedness of England and Wales now amounts to upwards of 300 millions—little short of £10 per head of the population. Of this huge sum, as nearly as possible one-half has been raised for undertakings which are classed as reproductive. The serious element in this half of the debt is not its present amount, but its steadily accelerated rate of growth. This element is especially evident in those portions of the debt which have been incurred for definitely trading purposes. To exhibit this, the debt for tramways, electric supplies, housing, and gas, has been distinguished from that representing water, cemeteries, harbours, and other more legitimate forms of communal adventure. Fig. 1 exhibits by a thick line the curve of increase of the total local debt, and by a dotted line that of the portion representing the four trading purposes above-mentioned. It will be seen that the dotted curve is very much the steeper of the two. Roughly, the general local debt doubles itself in 20 years, the strictly trading debt doubles itself in two years.

Fig. 2 takes a period from 1881 to 1900, and compares for certain typical cities the increase of the debt and the gross rates with that of the population and the valuation. It will be seen that the growth of population has been outpaced by the growth of the debt by no less than 500 per cent. in Sheffield, and by 85 per cent. both in Liverpool and London, and by that of the rates by as much as 115 per cent. in Sheffield, 180 per cent. in Cardiff, and 250 per cent. in London. The

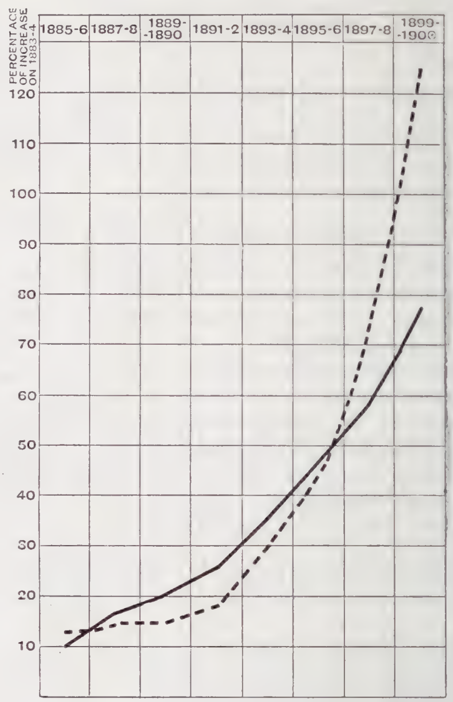

Fig. 1.—Local Debt of England and Wales, 1885-6—1899-1900.

The Thick Line represents Total Local Debt. The Dotted Line represents the portion of the Debt incurred for Electric Lighting and Supply, Gas Works, Housing, and Tramways.

valuation list fails to disclose any increment in the value of the property at all adequate to these heavy sums which have been charged upon it. In Manchester, for instance, the gross amount levied for rates has increased 178 per cent. in the period, but the property rated has only risen 12 per cent. in value. It is, therefore, difficult to discover any sign of pecuniary advantage to compensate for the

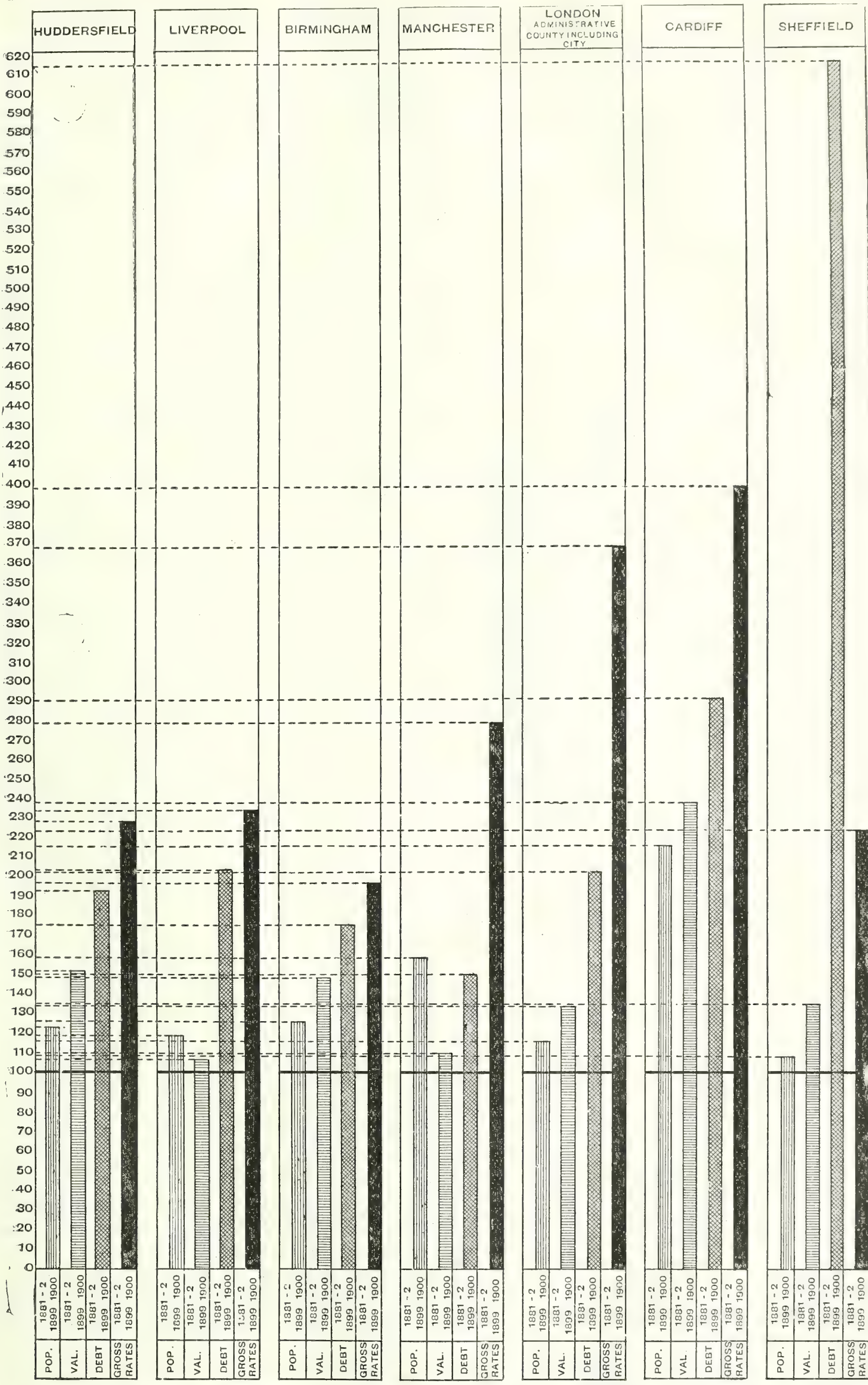

FIG. 2.—PERCENTAGE OF INCREASE OF POPULATION, RATEABLE VALUE, OUTSTANDING LOANS, AND GROSS RATES LEVIED DURING THE PERIOD 1881-2—1899-1900 IN CERTAIN TOWNS.

added burdens. Fig. 3 gives similar comparisons for the whole of England and Wales. The enormous increase in the amounts levied by the local authority is obtained not only from a higher poundage of the rates but also from an enhanced assessment of the property. For this reason the figure taken in the compilation of these charts is the amount actually collected by the authority—a more trustworthy test of the position of the ratepayer than is afforded by the usual comparison of the amount in the pound for which the different rates are made.

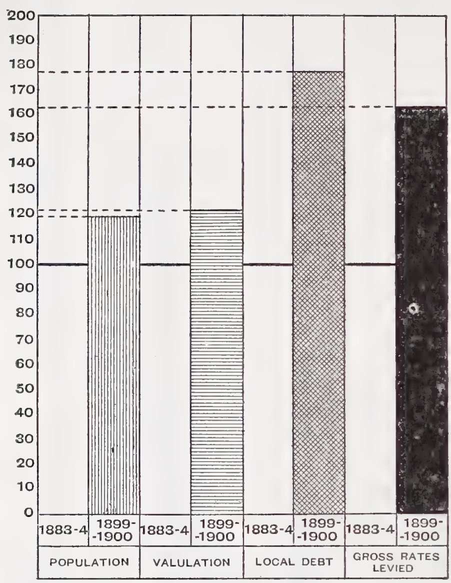

FIG. 3.—ENGLAND AND WALES. — PERCENTAGE OF INCREASE OF POPULATION, VALUATION, LOCAL DEBT, AND GROSS RATES LEVIED, 1883-4—1899-1900.

TAXATION WITHOUT REPRESENTATION.

Before leaving the figures, attention may be called to the increasing extent to which pecuniary responsibility is becoming divorced from control. An examination of the rate books has been made in two typical northern towns—Sheffield and Manchester. In each case the occupiers of the working-class houses represent more than half the voters' register, while the assessment of the whole of their houses amounts to less than that of the property of the manufacturing, railway, and other companies who have no vote at all. This disproportion is growing, for in both towns the companies' assessment has increased, in the ten years 1890-1900, upwards of 55 per cent., while the small houses only stand at 10·72 per cent. in Sheffield and 21·77 per cent. in Manchester more than they did ten years before (an increase due to the larger number of workmen's houses), so that while the disfranchised class has to pay half as much again, the artisan ratepayer and voter contributes much about the same as he did ten years ago to the treasury of his town. This state of things is well known to the advocates of municipal expansion, and is urged at the elections, upon the working-class voters, who are told that it does not matter to them what the rates are. Unfortunately, it matters a great deal in the long run to their class, for the increase of the rates offers a premium to the manufacturers to remove their works to a less burdened district, with the consequence of a diminished demand for labour in the town, and distress which falls most acutely upon the working class. These consequences are now in evidence in West Ham, where one ratepayer, the Great Eastern Railway Company, has had its rates increased by the enormous sum of £28,000 in the last ten years. This increase is largely due to the heavy burdens of the rapidly accumulated Borough debt. There is, therefore, no prospect of any diminution in the future. The excess is so large that its capitalised value is greater than would be the cost of removing the works to another place, a step which the Company are already contemplating as to a portion of the undertaking. People are apt sometimes to rest the blame of municipal abuses upon the democratic principle, but the slightest consideration will show that the democratic principle is not at work in the government of our towns. A democracy surely requires that taxation and representation should go together. The figures show that those who provide the greater portion of the funds for the authority are without any voice at all in the election of the local governors or in the control of their policy. So long as those governments confined themselves to matters of police, health, and education, no one complained, for these concern all the ratepayers equally. Trading undertakings, on the contrary, are not of equal concern, and the control of them cannot justly be vested, except in those who provide the funds for carrying them on. Property qualifications are out of fashion now-a-days, but if our municipal institutions are to be saved from the discredit and disaster which unjust practices of this kind will surely bring upon them, means must be found to confine them to the proper functions of government.

THE OVERRIDING OF THE COMMON LAW.

Upon the last occasion the Society had the advantage of an authoritative exposition of the legal aspect of the subject from Sir Richard Webster, the Attorney-General, now Lord Alverstone, Lord Chief Justice of England. Sir Richard pointed out that the investment of the public funds in a trading concern was at common law *ultra vires*, and illegal. How, then, the man in the street may ask, has it come about that these funds have been so invested to the extent of millions? It is accomplished by means of private Acts of Parliament, by which direct statutory sanction is obtained for each undertaking. Private Acts are frequently run through the Houses in a more or less hole-and-corner manner, and in order to impose some check the Borough Funds Act, 1872, was passed. This Act is supposed to provide that no Bill shall be promoted by a town unless with the overwhelming support of the inhabitants. It provides for a special meeting of the ratepayers, at which a majority must be secured in favour of the Bill. In theory this sounds all right. If the ratepayers do not choose to come to the meeting, it is their own fault; they have only themselves to blame if schemes are adopted which afterwards they do not like. In practice the check is inoperative. Ordinarily very few attend the Borough Funds meeting, and the officials have a difficulty in securing a quorum. Still a poll can be demanded, and at a poll the large ratepayers have a cumulative vote of one vote for every £50 of rateable value up to £250, and this vote can be given by proxy. This, however, is of no practical avail, for such ratepayers are few in number. It is, as a rule, quite impossible to arouse the electorate generally to give any attention to the matter. A most determined attempt to do so has just been made in Birmingham upon a proposal of the Corporation to promote a Bill for the acquisition of a large system of tramways at a cost of some two millions of money. A ratepayers' association was formed, and a regular organisation was established. Pamphlets were distributed. The local press, without exception, gave space to the subject for months before the poll. Public meetings were held on one side and the other. No local question had ever been more vigorously canvassed. In the end 15,742 voters were persuaded to go to the poll out of a total register of 102,712—about 15 per cent. At an ordinary municipal election, the poll in Birmingham exceeds 50 per cent. of the register. It is quite possible to arouse the attention of the electorate to civic matters of general welfare, but the ordinary member of the public refuses to waste his time over other people's trading concerns. The few who do vote are mainly municipal *employés* who are beaten up by their own foremen, and at Birmingham they were brought up in gangs, under the personal superintendence of the aldermen and councillors who were chairmen of the different committees. In Birmingham, there are said to be about 10,000 persons employed by the Corporation in one capacity or another; the tramway servants affected by the scheme would number some thousands more. The bulk of these are voters, and constitute a solid body, against whose direct interest it is hopeless for an opposition to make any headway.

SELF-INTEREST THE MOTIVE.

The truth is, that the pushing of municipal trading, like any other trading, is left to those persons who are interested in it. Self-interest remains the motive, notwithstanding all the parade of civic patriotism. Self-interest competing in open rivalry is a most useful commercial virtue. Self-interest masquerading in the ermine of impartial authority, intriguing up the back stairs, and demoralising the impartiality of voters, is a corrupting and degenerating influence. It is not, of course, denied that many people whose motives are unquestionable are fully convinced of the righteousness of municipal trading, but these people do not realise how much safer it is to trust to traders to interpret the commercial demand of the community, than to rely upon the discernment of officials or of governors. The railway enterprise will afford an example. Pease and Stephenson, after cautious experiments in colliery sidings, had the audacity to make a short steam railway from Stockton to Darlington in 1824. Their friends thought they were mad. The event proved they were right. But it was ten years later before they had the courage to attempt a second venture—the Manchester and Liverpool. All this time they had been educating other capitalists to a knowledge of the new industry, and studying its conditions themselves. They could not go to the Manchester Corporation, as the Ship Canal has done, and get a compulsory levy of 1s. 4d. in the £ on the ratepayers. That would have been a quicker way of getting the money for one railway, but had it been resorted to there would soon have been an end; the public purse could not have found

£1,250,000,000, which is the present investment in the railways, a sum not far short of twice the national debt, and nearly three-quarters of the entire wealth of the country at the beginning of the century. The power of private enterprise to expand is limited only by the demand, and the demand serves as an automatic stimulus and check, always proportioning it like the governors of an engine so that it neither races nor lags. Governmental enterprise is without this automatic adjustment. Its command of funds does not depend upon the success or failure of its undertakings, but upon the credit of the ratepayers. It will progress or stagnate according to the disposition of its elective body. Industrial advance is not secured by the average opinion, but by the original thought of one or two men who take a line of their own, and prove themselves to be right before the stern tribunal of the market. They benefit themselves certainly, but they benefit society still more, and they furnish a demand for labour far exceeding any that could result from the most progressive of County Councils. The above amount of railway capital, huge as it is, is much less than that which has been from first to last employed in the trade. The consequence of leaving it to private citizens was that those were most active in the new industry who could see their way to make most out of it, and so there grew up the great firms of railway contractors—Brassey, Peto, and the rest; and of manufacturers of railway plant of all kinds. These houses found a very large employment abroad, where the contrary policy of Governmental initiation of railways gave no such stimulus, and so these countries were dependent upon English and Scotch traders for their railway schemes and railway material, just as we are now being supplied with our electric schemes and electric machinery by Americans and Germans, electricity being a free trade in those countries and a municipal trade here. But it is often said "local authorities look only to the public good." There is a fallacy here. What is the public good? The local authority has to consider the immediate supply of a pressing local demand. It ignores altogether the general interests of commerce. These are out of its ken, and yet they are of far more importance to the future of the country than the partial local interests.

The Stifling of Trade.

The slow stifling of trade is not apparent, but it is certainly going on as a consequence of this absorption of commercial opportunities by these authorities. No less a sum than £400,000 has been expended by them between 1892 and 1898 in opposing projects of private adventurers in Parliament. This costly and obstinate opposition, undertaken in many cases in order to secure protection for municipal trade, constitutes a very serious hamper upon initiative enterprise in this country. We are accustomed to condemn the picketing activities of the trades unions. The Corporations are performing much the same function, that is to say, they are continually seeking to deprive men (and their own ratepayers, too) of the opportunity of working according to their own choice of employment.

Financial Commitments and Expedients.

Other consequences scarcely less fatal are perhaps more obvious. Take the financial aspect. It is hardly possible to exaggerate its seriousness. The debt is large now, but it is destined to be very much larger in the near future. Look, for instance, at the Corporations' tramway business. A recent return showed that there were 777 miles of electric tramway in the United Kingdom. In the United States there are 20,000 miles. The best equipped American towns have one mile of tramway for each 4,000 of the population. Apply this standard to England and Wales. In 1901, the Urban population of England and Wales was 25,054,268. To allow for small Urban districts where tramways are not necessary, give one mile of track to each 4,500 of the population. England and Wales would then require 5,568 miles. Take the cost of the cheaper overhead system, viz., £7,000 per mile of track. The total outlay which ought to be incurred would then be £40,000,000. But when this is done the enterprise must still progress. The capital account of a commercial concern cannot stand still. The railway capital of this country has increased tenfold in fifty years. How can a lower factor of growth be taken for these not less important street railways? The authorities, therefore, will have to take their choice; either they must keep their people without modern locomotive appliances, or they must face an addition to the local debt on this account alone of at least 400 millions during the next fifty years. It may be said there is a third alternative. They may not seek to supply the whole of the tramways which are wanted, but only such of them as private enterprise fails to provide. But this is an alternative which in the long run will not be found open to us. All

experience shows that where a Government undertakes a part of a service, it sooner or later has to take the whole. The citizen will not go into partnership with the Government; nor will the Government permit him to compete with it. The Justices of Speenhamland thought thoy could supplement the wages paid to the agricultural labourers by the farmers. They quickly found that they had to bear practically the whole of the burden of their support. The Provisional Government in 1848 thought they could reinforce private employment by the Ateliers Nationaux. In a few months they had all the workpeople of Paris on their hands. A similar tendency is at work in the building trade of London at the present time. Prior to the London County Council undertaking the construction of artizans' dwellings, there were many private companies engaged in providing the best class of such houses. Their enterprise has now practically ceased, and the result is a very serious house famine in London, and a not less serious addition to the obligations of the Council. The advocates of municipal trading are fully aware of this monopolising tendency. In fact they justify it, and do not hesitate to use the powers of the authority and their political influence to suppress any rash traders who may venture to attempt to continue the uuequal competition. "Socialists," we are told in a paper read at the National Conference on Housing held in London in 1900,—"Socialists should aim at getting the housing of all people into the hands of local authorities as soon as possible." Have people counted the cost which these responsibilities would impose on the public purse? Have they looked ahead and reflected for one moment upon the financial outlook? Take the case of electric supplies—another illimitable field of commerce into which the authorities have embarked. The manufacturing community will require to lean on the electric station for their power supply in the near future. They must not be stinted in such an essential respect. Yet here, too, as shown in the last paper, the municipalities ruthlessly suppress competition and demand an absolute monopoly, apparently regardless of the fact that monopoly involves a great responsibility. Gas is another industry which cannot be starved of capital. Water is a question of hundreds of millions, and there are many more which, though not yet undertaken by the Corporations to any great extent, are "upon the list." Mr. Vicary Gibbs has compiled the following list of industries, for which powers are being applied for by various authorities:—

"The manufacture of steam engines, dynamo, gas and electric fittings, and paving materials. Cold-air storage, ice manufacture, milk supply, concert rooms, shops, saloon and refreshment rooms, hotels, Turkish baths, and cycle tracks. Tramcar factories have been established, and even a brass foundry to make fittings. Municipal telephones are being largely undertaken, and a system of universal municipal fire insurance is being discussed. Municipal banks and the issue of municipal bank notes, municipal pawnbroking, municipal bakeries, and even municipal public houses have all been seriously suggested. Municipal collieries have been under discussion in the North of England, and the Bradford Corporation has actually proposed to supply coal for retail consumption."

One need not speculate upon the extent to which this remarkable programme of municipal adventure will be carried out in order to form a judgment as to the financial future. Even if the Corporations were to undertake no more industries than they have done already they will soon be faced with this dilemma. Either they must increase their present indebtedness to an extent which will overwhelm their credit, or they must starve their industries for want of capital. It is possible that both catastrophes may occur unless a change is effected in their policy. The idea seems to have prevailed that they had an unlimited command of capital. It is quite a delusion. Four years ago the present writer ventured to prophecy that if the sinking fund were suspended no Corporation in the country could borrow at 3 per cent. Though that event looked unlikely at that time it has since happened, and the result has established the correctness of the forecast. For the London County Council, which has the best, because the least burdened, of all the municipal securities, has just placed a 3 per cent. loan at less than 98½. Another large Corporation recently made an issue of two millions of 3 per cent. stock at the price of 94. The public only subscribed for about 10 per cent. of the amount offered. There are other indications that several Corporations have already felt the pinch of impaired credit. Some of the expedients to which they have been driveu are at best questionable. They have not only borrowed largely from their bankers, but they have also made issues of bills to the extent of millions direct upon the money market. This last device for raising the wind is, it is submitted, a highly reprehensible form of municipal trading. The Mercantile Bill is an instrument of barter of

great utility in supplementing the currency and conserving our very limited cash resources. The *raison d'être* of such a Bill is a trading transaction, such as a sale, which is morally certain to place the drawer in funds to the amount of the bill by the date of its maturity. The occasion of the municipal bill is very different—probably an outlay upon some extensive works or other which will bring no returns for years. Its *raison d'être* is not a liquid asset, but a more or less permanent debt. The authority has no certainty of being in funds at its maturity. On the contrary, the bill is issued for the very reason that the only resource for its discharge, viz., the sale of some funded stock, is not at the time a marketable commodity. Whether a purchaser will turn up before the due date of the bill is wholly conjectural. Such bills as these instead of husbanding the cash resources of the country, wastefully exhaust them, by withdrawing short money from the money market and applying it to lock-up purposes—a very similar process to that which led to the collapse of Australian credit ten years ago. No doubt these bills are modelled on the Treasury Bills, but no one who knows the difference between the market for consols and that for the securities of a local authority would allow the analogy for one moment. Have these ardent advocates of municipal adventure considered what would happen if a town should fail to meet their bills or to get a renewal, an event by no means so unlikely as is generally supposed? The *Times* recently referred to the case of an important borough which had been refused further advances by its bankers, and only just escaped a real financial crisis by inducing one bank, more compliant than a number of others which had been tried, to let it have sufficient to tide matters over. In the United States fifty years ago there were several such failures, caused, be it noted, by the embarking of the public funds in railways, canals, and other adventures which did not eventuate so rosily or so rapidly as was anticipated. In several of the States repudiation occurred. Probably such a collapse could never be allowed here nor would it now be permitted in the United States. To avoid it the Imperial Government would have to step in and support the local body by the credit of the country at large. But though such action would avert a financial disaster, it would be a terrible blow to those high hopes which have been formed of the future of municipal institutions. The mere possibility of such a resort suggests a preposterous state of things. The country has built up an elaborate system of constitutional safeguards to protect the public purse from irresponsible depletion even by the Legislature, and yet it has been left possible for the local authorities to incur almost without check liabilities, the burden of which may at any moment be thrown upon the taxpayer. You have erected massive fortifications on the Thames, and have left every other port in the country defenceless and open to the depredators.

Profits and Sinking Funds.

Of course, the supporters of the present municipal policy do not admit that the financial risks which they are incurring are of a serious nature. They rely, in the first place, upon the profits of the undertakings, and, secondly, upon the sinking funds which they are building up, and which they fully believe will extinguish their indebtedness by regular instalments, and leave them possessed of valuable undertakings clear of burden. Alas for human credulity! In both respects these optimists are the victims of delusion. It is true that the councils duly appropriate balances each year from the various trading accounts to the relief of the rates, and they speak of these balances as profits. As a matter of fact, in most cases they are nothing of the kind. At a recent meeting of the Incorporate Institute of Municipal Treasurers a strong protest was made against this practice. One experienced borough treasurer spoke as follows:—

"Some of us know that it is extremely difficult to save any balances of net revenue accounts—I do not call them profits, they are not profits—from being taken to the relief of the rates. Some contingency comes along by which your rate may have to be increased, and should be increased 6d., or even 1s. in the £, but this has often, dishonestly, as I maintain, been obviated for the time, and the burden of it thrown on the future ratepayers by means of taking profits—that is, so called profits—to the relief of the rates."

The following extract from the memorandum issued by the Local Government Board to accompany the return of local taxation in 1899-00 strongly attests the illusory nature of these profits:—

"It must be remembered, however, that the sums shown as received and expended in respect of these undertakings (*i.e.*, reproductive) do not constitute the full receipts and expenses on the several accounts, but that a certain proportion of the sums ex-

pended under 'Salaries' and 'Establishment Charges,' and a large proportion of the sums expended in the repayment of the principal of loans and the payment of interest thereon, are in respect of such reproductive works. . . . . It is not, therefore, possible to state from the returns to what extent the reproductive works undertaken by these local authorities resulted in a net profit to the ratepayer."

At the Royal Statistical Society, Sir Henry Fowler analysed the whole of the accounts of the local authorities, and showed that, in order to meet the interest and sinking fund instalments with a margin over of about 10s. per cent., the authorities had cut down the provision for depreciation to one-eighth of one per cent. In many of the towns no allowance whatever is made for depreciation, and yet the councillors unblushingly appropriate "profits." The specious argument is used that the sinking fund is a sufficient provision, and no further depreciation deduction need be made. The period of the sinking fund varies from 30 to 50 years. In London it is 42 years, generally. But electric machinery has often to be scrapped in eight or ten years if a power or tramway plant is to be kept up to date. To neglect to provide for this antiquation out of each year's revenue, is simply to cheat the ratepayer of to-morrow out of his just inheritance for the sake of keeping things pleasant with the ratepayer of to-day. "Dishonest" is not too strong a word for the borough accountant to use in regard to such "profits."

The sinking fund is fast becoming almost as delusive as the profits. In most modern Acts the Corporations take power to invest their sinking fund in their own concern. The clause inserted runs as follows:—

"Where the Corporation are authorised by any statutory borrowing power to raise money for any purpose they may, instead of exercising such borrowing power by the issue of any fresh security in respect thereof, exercise the said power, and raise the said money either wholly or partially, by using for such purpose any money for the time being forming part of the redemption fund."

So that when the loan matures for repayment it is found that the sinking fund provided for its redemption is not available for the purpose, having been put into other Corporation works. Therefore, a new loan has to be raised, and so to all intents and purposes, the borrowing is perpetual. It is the difference between paying a bill and renewing it. The sinking fund may furnish some comfort to the conscience of the municipal financier, but it will not serve the purpose of introducing any finality into Corporation liabilities.

Unreasoning Optimism.

One can understand, although not excuse, self deception of this kind in the accounts of a Liberator Building Society, but whatever can be the temptation to our public Corporations to resort to such devices? It must be an unreasoning determination to paint a fair picture of municipal trading. This spirit received a curious illustration in the recent case of Tunbridge Wells. This town had established a trading undertaking in telephones. As is apt to happen sometimes in business ventures, it did not turn out successful. After a few years the Corporation found their estimated expenditure had been greatly exceeded, and their actual returns were sadly below those they had hoped to realise. They proceeded to do what probably any business man would have done under the circumstances, cut their loss and sell the concern on the best terms to somebody else. This prudent decision aroused a storm of opposition, not from their own ratepayers, but from the Municipal Corporations Association, a body which seems to exist for the purpose of fostering municipal trade. Eloquent aldermen were brought from distant parts of the country to raise an emphatic protest on the ground that it would never do for a Corporation to admit that municipal trading could possibly have been under any circumstances a failure. Such indiscriminating optimism would be ludicrous if it were not pathetic.

Cant of Collectivism.

The advocates of municipal trading seem to take a delight in casting all possible odium upon the ordinary ranks of commerce. Their hack writers in the Press are continually pursuing the topic. Siuce the present agitation against municipal trading was started, those who took a leading part in it have met with an amount of abuse, which, having regard to the usual history of such movements, must be quite gratifying to them. The genial method is to institute a private enquiry into the personal antecedents of the reformers, and if they can be found at any period of their career to have had any connection, professional or commercial, with a wicked company (every company is to these gentlemen wicked, and they generally call it a trust), the fact is paraded as an argument that such persons, whenever they make any utterance upon a public question, are actuated by

the most selfish and sordid of motives. Apparently the assumption is that the municipal body is the sole repository of civic virtue. All this is ridiculous nonsense. It is in very much the same spirit as the attack which was made upon the Corn Law reformers. It was perfectly true that Cobden and Bright first observed the evils of the tariffs in the course of their experience in their own businesses. It is equally true that those businesses benefited along with the rest of the industrial community by the introduction of Free Trade. Has that diminished in the slightest degree the honour which belongs to them in connection with that great reform? If a business man or a professional man perceives a dangerous disease imperceptibly creeping over the commercial organization, it is his duty to his country to proclaim the result of his diagnosis and to agitate for immediate remedial measures.

At a public meeting held recently in the City of London, at the Chapter House of St. Paul's, an eminent dignitary of that Cathedral, in reply to a remark that municipal trading would stifle private enterprise, is reported to have said, "So much the better, private enterprise is played out in this country." It is too mnch the fashion to promulgate pernicious fallacies of this kind. The mere preaching of them does an infinite amount of harm—the harm that comes of calling good things evil. A single fact will dispel this ignorant charge. Mr. Bowley has recently published the results, of an elaborate investigation into the position of the working class and of the income-owning class in 1891, as compared with 1860. He found that wages had gone up 40 per cent., and income 47 per cent. in money, while the purchasing power of money had gone up another 55 per cent., so that practically speaking, people are double as well off in the country to-day, to what they were 30 years ago. This is the result of private enterprise. Wealth has accumulated enormously. Perhaps the reverend gentleman referred to would not regard this as a benefit; but there can be no greater stimulus to the establishment of new industries than the existence in the country of large accumulations of capital, and new industries must be continually established in order that the labour market may be compensated for the constant introduction of labour-saving appliances.

The Effect on National and Civic Character.

There are some charges, however, which need not be true in order to be injurious. If persons who are entitled to be looked up to as leaders of opinion, persist in saying that British people are less vigorous, less strenuous, less enterprising than they were, the people themselves will be very apt to accept that view. They will act accordingly, and will cease to be enterprising. Already signs of stagnation are beginning to appear. People are getting accustomed to it, and they will be disposed to acquiesce in the view that it is due to national character, and regard British shortcoming as a law of nature. It is not generally perceived that private adventure has, on the other hand, a stimulating instead of a demoralising influence on the national character. The capital for any undertaking, whether it be municipal or commercial is, of course, in the long run, provided by the abstinence of the people. In the case of municipal concerns the abstinence is compulsory, and more or less unconscious. Where, however, the undertakings are started privately, there has to be a spontaneous effort of self-sacrifice and thrift on the part of those who find the money for them. It is by the continual exercise of these efforts of independence and adventure and economy that the commercial character of a nation is built up. In no country have such efforts been more general than in England, for the reason that in no country has there been in the past a larger measure of freedom in commercial matters and security—the two elements which encourage adventure. Capital is not so readily forthcoming for a genuine commercial adventure now-a-days as it used to be. So many opportunities are offered for the investment of money in rate-guaranteed securities which involve no risk and make no call upon judgment that the capitalist is tempted to accept the position of a mere *rentier*. Perhaps it is for this reason that we find commercial opportunities being developed over here by American capital, a very different state of things from that which prevailed fifty or sixty years ago, in the days when the introduction of steam machinery made great demands upon the commercial spirit of the capitalists. Thus we see that money is not the only public asset which this communism succeeds in squandering—the national character is itself affected by it.

There is still another danger which underlies this municipal trading. It tends to damage the political credit of our municipal institutions. Every communistic proposal put forward by the governing body offers a temptation to the workpeople to grasp at a momentary advantage

and let the future take care of itself. In this manner it substitutes individual for corporate welfare as the motive of the working-class voter, and so the patriotic ideal is over-mastered by self-interest and the democratic judgment is poisoned. In his civic capacity our Constitution expects a voter to be altruistic; Communism tempts him to be egoistic. These dangers have been already realised by several influential members of our municipal bodies. Mr. Alderman Woodhead, M.P., recently said:—"The theory is rampant in some municipalities that it should be the privilege of all to avail themselves of the facilities to be provided by the municipalities, and that only a few should pay." He went on to say that in Huddersfield the election exigencies of a number of the councillors caused them to have at least two routes upon their tramways which not only did not pay, but which almost certainly never would pay. The extensions were made and the cars run upon them almost empty backwards and forwards, and the Corporation are losing very heavily. A similar spirit has been remarked upon by eminent members of the Corporations of Liverpool, Glasgow, and Newcastle-on-Tyne, and by the well-known town clerk of Birmingham, Mr. Orford Smith. These gentlemen are of opinion that the Corporation *employés* should be disfranchised. Surely it would be better to remove the temptation by keeping commerce and adventure out of the arena of local politics, both for the sake of commerce and for the sake of the politics.

Supposed Advantages of Municipal Trade.

(1) *Cheap Money.*—Enough, perhaps, has been said of the dangers of municipal enterprise. The advantages claimed for it may now be considered. We have not lately heard so much about the economy of cheap borrowing. It is probable that, what with bank loans, bill issues, and the diminished demand for municipal securities, our local bodies are paying as much for their borrowed capital as are our sound commercial firms.

(2) *The City for the Citizen.*—One still hears the argument that the municipalising of an undertaking will keep out the outside capitalist, but we must remember that the Corporation is not a capitalist itself. It is only a go-between. There is just as much outside capital employed when the town does a thing as when a company does it. In fact there is more, for the reason that a company has a larger knowledge of the business at its command, and by means of that is able to get the work done much more cheaply. People appear to doubt whether Corporations are in this respect at any disadvantage as compared with companies.

(3) *Better than Company Direction.*—It is asserted that the qualifications of a board of directors are no higher in a business sense than those of the members of a town council. No doubt in many cases this is so; at all events, Mr. Labouchere's Christmas number would have us believe it. Certainly companies do not always succeed. But there is soon an end to an unsuccessful company. If it cannot pay dividends it cannot raise more money, and it has to be wound up and sold to another set of persons who have a better knowledge of the business, or a better credit, or in some other way think that they can manage to succeed where their predecessors have failed. In this manner there is a process of selection at work, both in the direction and in the staff of company management, which is not present in the case of Corporations, for, although undoubtedly there is a day of reckoning ahead for unsuccessful Corporations, it is not anticipated, and the fear of it does not operate as a wholesome stimulus. In private business the consequences of incompetent administration or finance come quickly. In communities the operation of causes is slower, their action obscure. Decadence precedes catastrophe for years, accompanied by much suffering.

(4) *Regard for the Consumers.*—It is supposed, however, that a Corporation having only the good of its citizens in view, will be likely to administer the undertaking in favour of the consumer, whereas a company would run it for the sake of making a profit for its shareholders. It does not by any means follow. The highest prices do not generally mean the largest returns. The profit of the shareholder is not to be avoided in the interest of the consumer, but on the contrary to be encouraged, as is shown by the following hypothetical case.* Suppose a company's tramway, which carries two thousand passengers a day, and charges them 3d. a head. When its accounts are made up, they show the following as the result of the day's work:—

* See Symposium on Municipal Trading in "Traction and Transmission" for 1901-2, where the writer used the same figures.

Passengers	2,000
Fare	3d.
Gross receipts	6,000d.
Working expenses	4,500d.
Ratio of working expenses to receipts	75 p. c.
Profit	1,500d.

The manager advises the directors that he could carry double the number of people without materially increasing his working expenses. The directors decide to try the experiment, and, in order to attempt a larger number of people to ride, they drop the fare to 2d. The bait succeeds, and the day's returns then show as follows:—

Passengers	4,000
Fare	2d.
Gross receipts	8,000d.
Working expenses	4,800d.
Ratio of working expenses to receipts	60 p. c.
Profit	3,200 p. c.

This has prospered so well that the directors venture again, and lower the fare to 1d. Result:—

Passengers	10,000
Fare	1d.
Gross receipts	10,000d.
Working expenses	5,000d.
Ratio of working expenses to receipts	50 p. c.
Profit	5,000d.

By each change the shareholder has benefited by an increased profit, but the public has also benefited still more. The value of the public benefit of the two reductions is 20,000d., nearly six times the benefit reaped by the shareholders.

Perhaps it will be said the Corporation will be just as eager to pocket a profit as the company, and therefore the stimulus of profit will be as operative in the one case as it is in the other, but in practice, it is almost impossible for a Corporation to resist the various influences which are continually at work to distribute any revenue balance before it can reach the pocket of the ratepayer. In London the County Council have leased their tramways on the north side of the river on terms which secure them a rent dependent upon the gross receipts of the undertaking. The tramways on the south side of the river they are working themselves. Before the County Council made the purchase of the undertakings, the South London trams had been exceedingly profitable, and no doubt the Council determined to retain them, with the idea that they would afford a conspicuous example of the success of municipally managed undertakings. From a financial statement made by Sir John McDougall in October last year, it appears that the profit formerly earned on the south side of the river had dwindled away, what with reductions of fares, reduction of hours, increases of wages, and other emoluments to the men, to the paltry sum of £9,000; and even that amount would probably speedily vanish if a proper depreciation allowance were made. On the north side of the river, on the other hand, the rent paid to the Council by the company working the North London tramways was £76,841. This, after providing for the interest and sinking fund upon the Council's outlay, leaves the net profit of £39,450, every penny of which is honestly available for the relief of the ratepayer.

A similar comparison might be made between the tramways of Dublin, which were started by a private company upon a freehold basis (for Ireland is in the fortunate position of not being subject to the Tramways Act of 1870, which compels all English and Scottish tramway companies to be started on a leasehold interest of twenty-one years only). This company pays about £20,000 a-year to the Corporation for their way leaves. Glasgow, which is three times as populous, and at least ten times as wealthy, had in 1901 only 44½ miles of tramways, as against Dublin's 52 miles, and for that year the Glasgow trams contributed to the Corporation £12,500 only. As to fares, in Glasgow they charge ½d. for a half-mile stage, in Dublin 1d. for a two-mile stage. The wages and conditions of the men also show a comparison quite favourable to Dublin. The greatest advantage of Dublin remains to be stated. Electric tramways and this cheap system of fares were started by private enterprise there in the year 1896. The Glasgow electric tramways were not running until 1901. Taking the method by which Sir John Wolfe Barry recently estimated the loss involved by obstructed street locomotion, in an able paper he read as Chairman of the Council of this Society, it would be easy to calculate that this tardy enterprise of municipal trading has inflicted upon the inhabitants of Glasgow, as compared with their contemporaries in Dublin, a loss equivalent to hundreds of thousands in every year. The fact should be borne in mind that although commercial profits are more or less out of the reach of municipal management it is quite open to the Corporation to make sure of a revenue from their undertakings by leasing them. By assuming the speculation themselves they commonly sacrifice both the profit and the

rent, just as a landowner does who keeps his farms in hand. It may be pointed out in this connection that the Corporation accounts never show any debit for the rent which they thus sacrifice, another evidence of the fallacious nature of their returns of profit and loss.

(5.) *An Escape from Trusts.*—Then it is said municipal trading affords the only escape of a community from the dangers of Trusts. The word Trust seems to be a sort of bogey cry which municipalists use for diciplinary purposes, much as nurses used to shout "Buonaparte" to naughty children at the beginning of the last century.

The Trust problem has presented itself as a serious difficulty in countries where the industries are subject to protection, so that the consumer is confined practically to the internal markets which can thus be controlled by combinations of capitalists. It is the protective support of the law which enables the combination to oppress the consumer. It is not the power of capital, but the legal monopoly which is the seat of the evil. In this country (if we perhaps except water) there is no reason why there should ever be any other monopoly than the monopoly of superior efficiency. A tramway down one street can be paralleled by a subway or tube down another street. Gas, which was at one time thought to be above competition, is now an alternative to electricity and petroleum. Hydraulic power has no monopoly. It shares its trade in many places with electric power, and in some also with pneumatic power supply. In private hands, the constant activity of invention, and the rivalry of commerce may be relied upon to secure in a free-trade country competition in one form or another, but upon the principle pointed out earlier in the paper the healthy stimulus and check of competition is always absent from an industry carried on by a Corporation. They have a legal monopoly preserved to them by their own bye-laws, and supported by such combinations as the Municipal Corporations Association, by means of which the united political power of the local bodies all over the country is focussed and exploited so as to secure for them a degree of protection which is absolute. So far therefore from municipal enterprise being a check upon the evils of Trusts, it will, on examination, be found to expose the consumer to all the oppressive conditions of the worst American combine.

(6) *Better Control.*—But there are certain industries which involve an amount of interference with public rights. These it is suggested cannot be properly kept under control, and therefore the only alternative to disorder is to have them municipally administered. The truth is that the authorities are so infected with the idea of acquiring them, that they do not honestly try to regulate them. Their policy produces a reactive tendency in the same direction on the part of the companies. A gas company or a tramway company sees expropriation looming through the fog of local controversy. Its conductors do not see why the authorities should choose their own time for the purchase, and therefore they themselves aggravate the situation in order to hasten the decision of the authority to buy out the company at the precise moment when it will suit them, in view of the depreciated state of its undertaking and of the capital difficulties ahead, to part with the concern. If the policy of acquisition were definitely abandoned the authorities would be able to enforce a much more effective system of control. Confidence would be established in the place of suspicion. It is quite unreasonable to expect, for instance, the railway companies to attribute impartial motives to the London County Council's efforts to regulate the accommodation of workmen's trains, when they know that the County Council is itself engaged in the carrying business to a very large extent, in direct competition with the railway companies themselves. A short time ago, proposals were made by the Manchester Corporation to regulate the heavy traffic in the streets of the city. These were received with an uproar of opposition from the owners of horse vehicles of all kinds, who could not be persuaded that the Corporation were not using their power for the purpose of clearing the track and gaining a preferential treatment for their own tramcars. On the other hand, in American cities, where anything like municipal trading is now practically unknown, the street railway companies are ready to invest millions of money upon an annual concession, knowing perfectly well that, so long as they behave themselves, the concessions will be renewed with the regularity of a publican's license. The American case proves, that as long as companies are not afraid of expropriation, they will be ready to acquiesce in the largest powers of control. On the other hand, what becomes of control when the undertakings are in the hands of the Corporation themselves? We hear of farcical prosecutions of the borough conductor, at the instance of the borough police, for overloading the borough omnibuses —a gentleman from the town clerk's office

appearing on both sides, and arguing the case before a bench of the borough magistrates. We see tramcars meeting almost end on in a continuous urban thoroughfare, and the passengers put to the inconvenience of changing from one to the other, in every journey, for years, for no purpose, except to mark the invisible boundaries and the bumble jealousies dividing two local jurisdictions. Verily may we cry, *Quis custodiet ipsos custodes.*

Suggested Remedies.

Having regard to these social, political, and economic results, it can at least be said that the intrusion of the authorities into the domain of trade leads to evils far greater than any to which their abstention from trade could possibly lead to. It remains to consider what means can be taken to put matters on a sounder footing. It is evident that Parliament is most reluctant to interfere with the action of the Corporations. No member of the House of Commons can be indifferent to the opinion of the local governing body, and the last thing he desires is to come into conflict with them. In local matters the municipal tail wags the Parliamentary dog. However, the following suggestions have been made:—

1. That Corporations should not be allowed to trade for the purpose of profit. This has the advantage of pleasing the Socialists, to whom the making of a profit seems to be a thing accursed. But even if no profits were made, it would (as pointed out in the last paper) still be unjust to use the credit of the town as a whole in order to establish an industry which will not equally benefit the whole of the citizens. Moreover, the influence of the Corporations in Parliament is such that they would sooner or later be sure to find a way through any regulation of this kind, as they did through the Standing Order prohibiting powers being granted to a Corporation to work tramways.

2. The disfranchising of municipal *employés*. This has influential support from within the ranks of orthodox municipalism.

3. It has been suggested that some limitation should be placed upon the financial powers of the local bodies. There is precedent for such a limitation both in the municipal law of America and in the English Public Health Act. The following is the language of each:—

Public Health Act, 1875, S. 234 (2).

"The sum borrowed shall not at any time exceed, with the balances of all the outstanding loans, . . . in the whole the assessible value for two years of the premises assessible within the district in respect of which such money may be borrowed."

New York Constitutional Amendment, 1884.*

"No city shall be allowed to become indebted for any purpose, or in any manner, to an amount which, including existing indebtedness, shall exceed 10 per cent. of the assessed valuation of the real estate of the city."

This limit of the Public Health Act is another example of the manner in which wholesome checks imposed by Parliament upon municipal extravagance are continually set aside and rendered nugatory. Almost every Local Authority's Bill directly repeals section 234 of the Public Health Act. This ought not to be allowed. It ought to be possible to make such an alteration in the Standing Orders as will prevent the limit being exceeded except in the same way in which an ordinary money Bill can be brought in in Parliament, that is to say, on the initiative of the ministers, and after consideration in the Committee of the whole House. In no single instance has the limit of two years borrowing failed to cover, and more than cover, the financial needs of any of our municipal communities for proper purposes of local administration. The excess of debt beyond that limit—amounting in the case of Huddersfield to over 3½ years assessible value—has in every single instance been incurred for trading.

4. Short of this a slight amendment has been proposed by Sir Alexander Henderson, which would undoubtedly do a great deal to clip the wings of municipal adventure. These bodies mainly rely upon Trust funds for the absorption of their securities, their Parliamentary influence having secured the granting of statutory powers to enable trustees to invest in municipal loans. This power is as follows:—Trustee Act, 1893, s. 1, ss. *m*. "Trustees may, unless expressly forbidden by the Trust instrument, invest in municipal stocks of towns of over 50,000 inhabitants, or County Council stocks issued under Act of Parliament or Provisional Order." The amendment suggested is—"Provided that the debt which any such stock represents does not exceed in the whole the assessable value for two years of the town or county in respect of which the stock is issued." Such an amendment would not only

* Similar provisions are in force in all the other States. Being part of the Constitution they are unalterable except by a convention, and are strictly enforced by the Supreme Court of the Union.

be an act of policy tending to restrict speculation with public funds,—it would also be an act of justice to those interested in trust funds, which it is to be feared are frequently invested under the sanction of the Trustee Act in municipal securities, without any regard being paid to the elements of risk which undoubtedly attend them, so long as trading is indulged in.

5. An effective and independent audit of municipal accounts is urgently required, and a strict and intelligent method of book-keeping by which the "teeming and lading" devices should be put a stop to, and the accounts of each department kept distinct. The present system offers unlimited scope for concealment and financial juggling. In this connection may a humble appeal be sent up for more prompt statistics. The figures for the year 1901-2 will not be published until March, 1903, so that offences have got stale before they are possible of detection and reproof.

(6.) The protection given by the Borough Funds Act (a Bill for the amendment of which in the direction of relaxing the restrictions, was brought in last session by Sir Albert Rollit) should be rendered really effective by allowing any ratepayer one vote in respect of every £50 of rateable value, without the limit of the £250 as a maximum. Such an amendment, giving those who have to bear the burden of these undertakings some opportunity of raising their voice against them, would be only reasonable. If, as is always contended, such concerns are going to be profitable, the business men who represent the large ratepayers would be the first to perceive this, and, of course, would be most eager to take advantage of it. On the other hand, they would also be alive to the risks of such ventures. There would thus be contributed to the council of the community, a leavening of harder business consideration than is generally given to proposals of the kind.

7. The difficulties and the disadvantages of legislative interference would not apply to the check which might be imposed upon the municipalities if the leaders of financial opinion in the country were to assert their influence. The present outlook is one of uncontrolled expansion; this cannot continue without danger to the money position. It is suggested that the situation calls for the serious attention of high banking authorities whose wisdom and foresight have many times before stayed the spread of economic disease and saved their country from years of disaster and distress. Experience shows how difficult and painful is the process of arresting a course of public expenditure once it has got well on its way; the great thing is to check it in time. No one is in such a good position to do this as the bankers. Bankers, and particularly the Bank of England, would be the first to suffer if the Corporations were to run too far and a crisis should arise. The present monetary situation affords a legitimate excuse for pulling them up. Increased taxation and a higher standard of living are making themselves felt, and bank deposits are not accumulating too plentifully. The regular industries surely have the first call for banking facilities. Therefore it is respectfully submitted that every attempt by Corporations to dip into bank balances either by direct borrowing, or by the issue of bills or receipts for short deposits should be definitely discouraged, and that such discouragement would be the safest as well as the most timely and efficient check which could be resorted to.

Whatever may be the remedy or remedies proper to be applied, it is highly important that some means should be found of stopping a practice which leads to unprogressiveness, arbitrary restrictions, and waste of capital.

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DISCUSSION.

The CHAIRMAN, in opening the discussion, said that four years ago when he presided over a previous meeting, at which the author read a similar paper, he had the pleasure of congratulating Mr. Davies not only upon the exceptional merits of the paper but upon the extremely attractive and interesting way in which he had brought a dry and technical subject before a mixed audience. It was not often that people twice succeeded in so difficult a subject, but he thought those present would agree with him that what he said on the previous occasion, on the first paper, was equally merited by the present. He would commence the discussion by reading a letter which he

had received from a very old colleague, a very distinguished man, who had taken a great interest in the subject, Sir Edward Clarke :—

"I am sorry not to be able to come this evening to hear the discussion of one of the most interesting and most important of public questions. I trust that we shall have a strong Royal Commission before any further trading powers are granted to municipal bodies. The burden of rates, recklessly increased, and unfairly levied, is very heavy, and the debts which will make that burden permanent, are increasing with alarming rapidity."

The opinion of such an experienced statesman and lawyer as Sir Edward Clarke showed that, at any rate, others who had not had the advantage of hearing the reasoning of the paper had arrived at some of the conclusions to which attention had been drawn. He desired to say nothing more than he said on the last occasion upon the legal questions — that undoubtedly the rights of Corporations to spend money in such undertakings must depend upon statutory authority, and it was extremely important that before fresh statutory powers were given the subject should be thoroughly understood, and the people who pressed their members to support municipal trading, should know to what point it was bringing the financial aspect and condition of the country. He had not either the means or the opportunity of testing figures, or of forming his opinion on them, beyond what he read; but the gravity of the question was really attested by the enormous figures to which local indebtedness had reached, and by the very rapidly increasing burden which would be forced upon the public if further obligations were to be undertaken, and further powers given. He wished to allude to one part of the subject which had only been touched upon by the author, but which he (the Chairman) as a Member of the House of Commons for a great many years had frequently had pointedly brought before his notice. The author had referred to the Municipal Corporations Association. Only those who had been in the House of Commons knew the really almost unfair weight and power which municipal bodies had in the House, because, not only did the local member not dare to resist the wishes of his local friends, but all the municipal corporations acted together, and when there had been an attempt to get statutory powers for private enterprise which was thought to conflict with the possibility of municipal trading in a particular place, not only was the influence of the municipality in that particular place set to work, but the influence, through the Municipal Corporations Association, of many other municipal bodies which had nothiag whatever to do with the particular scheme. Without fear of contradiction he could say that the question under those circumstances was not fairly determined upon its merits, and was not fairly discussed. Being no longer in politics he had no right to express any opinion upon the merits of the case, beyond saying that it was a question of such vast importance that it ought to be thoroughly understood and tested upon its merits and not dealt with by any considerations of popularity, public sentiment, or anything of that kind. There was brought to his notice some time ago the lamentable effect of municipal trading in the direction of the housing of the working classes. He believed it had had a disastrous effect. It was ridiculous and absurd to say that persons engaged in the building trade could expect to carry out such undertakings at a profit of 3 or 3½ per cent., and one had only to study the accounts most superficially to see that to a large extent the rates had to pay for some of the unproductive expenditure of Corporations in that direction. As those who had read the statements of ladies like Miss Octavia Hill, and others who understood the subject knew, what had happened to a large extent was that the genuine, good builder had been driven out of the field, and the only people who could now compete with municipalities were the jerry builders and people who did not put up substantial houses. The question ought to be looked at and investigated upon its merits. He wished to endorse what had been said by the author as to the necessity for a real audit of municipal accounts from that point of view. An opportunity was given of so presenting the figures that the real, true state of the speculation could not be got at, except by an examination of books which were not represented in the synopsis of the accounts that was given. That gave an opportunity for what he might call two evils. If the municipal trading was being carried on at an excessive rate of profit, it was an unfair act to the consumer who was paying for the article supplied to him, and he was then contributing in aid of the rates. That was a small evil, but it was an evil which might, in some instances, be of importance. But the other side was to him of far greater importance, namely the impossibility of finding out what had become of the unproductive capital which many Corporations had embarked in their undertakings; and it was because he felt, in regard to such local loans, towards which, as the author said, in so many instances trust moneys had been contributed, there should be no doubt as to their financial security, that they ought to know to what point they were going, if the system was to be extended to any greater extent. The point of his observations was that he trusted a thoroughly representative Royal Commission would be appointed to inquire into the matter. The author had stated that, although a large amount of evidence was taken by a Joint Parliamentary Committee, unfortunately no conclusion was arrived at. He hoped that whatever body inquired into the matter it would be independent of anything which he might call Parliamentary interest, that it would be thoroughly representative, that it would be composed, to a certain extent, of men who knew what private enterprise had done and

could do, who knew the value to the community of the competition of private enterprise, and that it would, at the same time, be representative of those who believed that, at any rate to a certain extent, municipal trading was for the good of the general community, and for the good of the individual communities in which such trading was carried on.

Mr. J. RATCLIFFE COUSINS, L.C.C., said that the London County Council, although it had indulged in several branches of municipal trading, had not, up to the present, dived so deeply in that respect as many of the provincial municipalities, consequently the proportion of the debt of London to its rateable value was not so large as that of Sheffield, Cardiff, Manchester, and other large towns. But the County Council had started on what he believed to be a fatal career. It had started a works' department, which had commenced building artisans' houses upon a scale very much larger than any other municipality, and had started the ownership and management of the tramway systems. It had erected accommodation for 60,000 people, and proposed to provide for an additional 80,000. The London County Council did this work under two heads, the clearance of slum areas, and the provision made for people who were removed in the course of making public improvements. That was a very necessary work in both respects, but the question was whether the Council should itself be the constructor of those buildings, or whether they should, after clearing the areas, let the land for a private company to erect the buildings. The Council were setting a bad example by not housing the people who were removed from the slums, by not providing accommodation at a rent which was within the means of those people, and therefore catering for a class of people which could be better catered for by companies. The Council purchased the land at whatever might be the commercial value, but when built upon, it charged against the building scheme a very much lower figure. The actual price given by the County Council for the land was £787,000, but it had charged against the Housing Committee only £162,000, thus writing down the value of the land obtained for the purpose of erecting artisans' dwellings by £625,000. No private company could possibly compete with a public authority with such large powers at its disposal, because a private company had to make a 3 per cent. return upon its invested capital; had to purchase the land, and could ask no fairy godmother to give it the balance between its commercial value and its value for housing purposes. That was a great danger to London. He believed the total cost of the scheme for providing accommodation for 80,000 people, was £5,000,000, and when one considered the enormous debt of London, it raised very important considerations. It had always struck him that the difficulty in dealing with the question was to divide the objects under heads which could be proved by returns for the municipalities, because the returns were so incomplete that it was difficult to make a statement applicable all round. But taking two towns like Manchester and Liverpool, which were very nearly the same size, in Liverpool the gas was supplied by a private company, and in Manchester by the Corporation. The advocates of municipal trading said that in Manchester there was a profit on the gas of over £50,000 a year, and quoted that as a strong illustration of the advantages of municipal trading; but that £50,000 profit had only been kept up by increasing the price of gas 3d. per 1,000 feet in 1900 and an extra 3d. in the following year. The ratepayers of Manchester had, therefore, paid 6d. per 1,000 feet extra for their gas in the last two years, in order that the Corporation might still be able to continue to say they made £50,000 a year profit on the gas. Those who were concerned in municipal management must look at the question not so much from the point of view whether municipal trading paid or not, as whether it was right for the functions of a municipality to enter into that particular field. There was a limit to the amount of work which a man could do upon a public body, and if there were added to the burdens of that body functions of a special kind which required special training, it was exceedingly difficult to find the right men to fulfil those requirements, and it put an excessive burden upon them individually which prevented them giving proper attention to the necessary questions connected with sanitation, which were their chief functions. The important question was not so much whether municipal trading paid, but whether the municipality was not damaged financially and morally, and made less capable of fulfilling their proper function by being encouraged to enter the field of competition with private enterprise. The rates might enable them for a time to compete, but he was convinced that ultimately there would be diminished profits: a heavy debt would accumulate on their shoulders, and the Corporation would have a concern on their hands which would not pay, and would have to sell it to the highest bidder.

Mr. J. R. MACDONALD, L.C.C., said he had listened with surprise to the last speaker, and thought Mr. Cousins would not have delivered such a speech in the presence of his colleagues at Spring-gardens. In giving the figures as to how the value of land was written down when municipal houses were built upon it, Mr. Cousins carefully refrained from informing the audience that the land must be let or sold under the specific condition that working-class houses were built upon it, the result being that even if the private builder were allowed to come in, the Council would still, unfortunately, have to present to the ratepayers of London a deficit upon the land which had been bought for improvements, when that land was taken up for the purpose of building working-class dwellings upon it. As a matter of fact, if the land upon which the Council had themselves built

artisans' dwellings, had been let or sold to private companies for the same purpose, probably the same sum would have had to be found out of the rates. If there was anybody to blame it was not the London County Council, or municipal enterprise, but the partly-mistaken policy of the Legislature in compelling them to re-house the same number of people on exactly the same spot where they had been previously housed. The policy looked very well, but he doubted whether, with modern social conditions, it had been a wise one. In regard to Mr. Cousins's statement as to how the Manchester Corporation made £50,000 a year on its gas undertaking, he believed that even now the price of gas in Manchester was lower than it was in Liverpool.

Mr. COUSINS stated that in Liverpool, under a private company, the price was 2s. 8d. per 1,000 feet, and in Manchester, under the Corporation, it was 2s. 9d.

Mr. MACDONALD said it therefore appeared that although in Manchester the price had been raised by 6d. in two years, there were only a difference of 1d. a 1,000 feet between Manchester and Liverpool at the present moment. But before an estimate of the value of the figures given could be made, and a real meaning be attached to them, more information was required on many points, including the cost of coal. No man who had seriously faced the question as a practical administrator would say that in every case municipal enterprise would compare favourably with a private enterprise in a town some miles away. The paper was bristling with statements which had no relation to each other, and with statistics that did not explain themselves; everyone of the columns of figures were compound columns, made up of an infinite variety of entities, but not one of the statements were single statements capable of comparison. Whatever conclusion was come to, he hoped it would be a scientific one. Those interested should approach the problem as careful statisticians, and try and give some value and meaning to figures, and not be content with adding up meaningless totals and throwing at people's heads meaningless assumptions. The author had asked them to consider whether municipal trading was increasing or lowerering the *morale* of local life. In Chicago, New York, Buffalo, and Philadelphia, that which had contributed most to raising the standard of municipal morality, had been a movement in the direction of municipal enterprise or trading. To suggest, in the face of such American experience, and similar German and French experience, that political and civic morality would be heightened by the municipal councils confining their attention to merely administrative and public health laws, was flying in the face of plain facts. So far as conclusions could be drawn from abroad, he thought the conclusion must be come to—that, at any rate, a certain amount of municipal enterprise did enthuse the members of a Council with a feeling that they had great responsibilities—and they rose to those responsibilities. He ventured to say there was not a single man present, whatever his dogmatic position might be in regard to the question, who would say that the London County Council ought to be mentioned in the same breath with the late Metropolitan Board of Works.

Mr. WALLACE BRUCE, L.C.C., in criticising the author's statements in regard to the writing down of the value of the land, said that the Metropolitan Board of Works after it had cleared away certain unsanitary areas, sold the land to the Artisans' Dwelling Company at the housing value, whereas it had bought it at the commercial value. If block dwellings were to pay, they could not be built on land which cost more than 5s. a foot. Land which was cleared, was often paid for at the rate of 25s. a foot, but it had to be written down to 5s. a foot, its actual market value, because it had to be used for housing.

Major-General WEBBER asked the members of the London County Council who was responsible for a Clause in a Bill now before Parliament in regard to general powers for electric lighting in London, which enabled the London County Council to buy at wholesale prices electric light fittings costing three-quarters of a farthing and a farthing apiece, and 1s. 6d. and 1s. 3d. per dozen, and sell them retail to those who wished to have their houses fitted up for electric light. No doubt it admitted of a full explanation, but it was a class of trade he should have thought the London County Council would not have initiated. Having served for many years on a valuation committee of one of the local authorities in London, he thought the valuation column given in Fig. 2 was not tall enough; in that respect the author had not made out nearly as strong a case as he might have done. The tendency of all valuation committees was to keep valuations down when there was no municipal trading, but whenever municipal trading became the order of the day, it was their endeavour to keep them up. There was one fundamental question behind the whole subject, viz., what was a day's work of a man—what was the amount of work which a man, in his particular trade, ought to give to his employer? He had superintended, both at home and abroad, work done by contract and on the principle of the Works Department of the London County Council, and the success of either process depended on the amount of work the employer obtained from the man employed. If they could get men to see that a good day's work was entitled to a good day's wage, the whole of the present extra cost of building, taking into consideration labour-saving appliances, would come down per cubic foot to the price it was fifty years ago. It was the "go easy" day's work, which had been instilled into the minds of a large number of the excellent artisans of the country, which was responsible for the

mischief. The man would not do the work for the reasons described by the author. He hoped the whole question would be scientifically worked out.

Mr. T. DUNDAS PILLANS disavowed on his own behalf and on behalf of those who took the views of the author that they were actuated by any hostility towards the municipalities; they thoroughly agreed with Lord Rosebery in the masterly enconium he passed upon the civic duty, which ought to impel a man to offer his services to the locality in which he resided in order that he might take part in the local government of the locality and do his best for his fellow citizens. The position he took up was that municipalities would be much better employed and would perform their functions much more efficiently and satisfactorily if they restricted themselves to their proper functions, and left to the proper people those trading enterprises which depended largely for their success upon the motive of self-interest, and which could be best conducted by those who had a personal interest in them. Six years' experience had convinced him that it was impossible for a municipality to conduct successfully trading enterprises, because the motive of self-interest was absent, and the individuals who conducted the enterprises had no direct personal incentive to make them a success. He thought municipal industrial enterprise must fail, because the gentlemen who were elected to town councils were, in the main, not elected because they were fit and proper persons to undertake industrial enterprise or commercial transactions, but for a hundred entirely different reasons. Mr. Macdonald had said it was unfair to institute comparisons between one city and another, and to say that one town succeeded in a certain industrial enterprise where another town failed. The South Metropolitan Gas Company had succeeded because of its Chairman who had done so much for the working classes, and had succeeded in emancipating himself from the tyranny of the trade unions; and it was because the Gas Light and Coke Company were subjected to the very influences which he suggested would be dominant in the town councils that the Gas Light and Coke Company was a comparative failure, and the South Metropolitan Gas Company a triumphant success. The Liberty and Property Defence League had been instrumental during the last 20 years in preventing the repeal of the wholesome Borough Funds Act, and if the League had done no other work than that, that alone justified its existence. He submitted that the author's figures had passed practically unchallenged, and that he had proved the points he had put forward. He supported the suggestion that a Royal Commission should be appointed to enquire thoroughly into the question, so that if the people of the country did go in for municipal trading, they would do so with open eyes.

Sir FREDERICK BRAMWELL, Bart., F.R.S., said he wished to re-ventilate a very old grievance. In 1870, the Tramways' Act and a general Act were passed. Under the general Act, after 21 years the municipalities might purchase the undertakings compulsorily, but they could not work the tramways, but had to lease them. Later on, the Electric Lighting Act was passed, in which were embodied the provisions of the Tramways Act as to the powers of the municipalities to acquire, but the municipality was no longer restricted from working. The Act further stated that if the municipality did not like to purchase at the end of 21 years, at the expiration of another seven years its option might be renewed, and so on, from seven years to seven years. Putting it in plain English, it meant that, as long as it did not pay, the municipality were not bound to buy it, but directly it did, they were entitled to take it. He and others did all they could to prevent anybody going to work under the terms of that Act, and after a period of six years they managed to get the period specified in the Act extended to 42 years instead of 21 years. In the meantime the United States and Germany went to work, prospered in their work of machine making, with the result that at the present day England had lost for ever the manufacture of electrical machinery. His friend and partner, Mr. Harris, would be able to state that out of many thousand pounds worth of machinery his firm had ordered, the bulk of it had either come from America or Germany. As the chairman of an eleetric lighting company in London, he had also to state that the whole of the equipment for a new generating station which had been erected, with the exception of the engines and boilers, came from abroad, because they knew it would be good, both in manufacturing details and scientifically, and they knew the promise could be relied upon as to when it would be delivered. It was to him a matter of the deepest regret to think that from the desire to pander to municipal trading, which caused the Act to be passed, England had, he believed, for ever lost her proper position in the manufacture and supply of electrical machinery.

The CHAIRMAN, after expressing his gratification at the manner in which the discussion had been conducted, said he wished to take exception to one remark made by Mr. Macdonald, which he had heard put forward before in other assemblies, viz., the somewhat vain-glorious comparison between the London County Council and the Metropolitan Board of Works. He yielded to no one in his admiration for the work done by the London County Council. While the Council had embarked in many schemes of which he did not approve, everyone was most grateful to the gentlemen who served upon the body; but from the point of view of public works and public improvements, they had no right to say they were so far superior to the Metropolitan Board of Works. He looked back to the work done by the Board of Works in connec-

tion with the Victoria-embankment, the purchase of the bridges, Theobald's - avenue, and scores of other streets, and thought the members of the London County Council would not in any way injure their own position if, when they spoke of the Board of Works, they did not always indicate that they were so vastly superior to that body.

On the motion of Mr. SYDNEY MORSE, the discussion was adjourned to Friday evening, February 6th, at eight o'clock.

The EARL OF WEMYSS writes:—

I greatly regret that I am unable to attend the meeting to which I have had the honour of being invited on the subject of municipal trading. Ten years ago I sp ke strongly on this most vital question at a meeting of the Paddington ratepayers, and I then said that "the municipalisation of what have hitherto been private undertakings means, in the long run, a short-sighted policy fatal to municipal and national progress." I further spoke of its comparative "waste, inefficiency, and possible unlimited jobbery." All I think that has since occurred confirms the soundness of this view of municipal trading, and I hope the result of your coming discussion will be to urge upon the Government the need at the present time of completing the unfinished public inquiry into municipal trading; and that this inquiry should be by a Royal Commission. Had it not been that the answer given by Mr. Balfour to a question on this subject in the Commons seemed favourable to further inquiry, it was my intention in the autumn session to have moved in the Lords for the appointment of a Royal Commission.

Miscellaneous.

ON THE EARLY APPLICATION OF MAGNETO-ELECTRIC MACHINES FOR ELECTROMETALLURGICAL PURPOSES.

The application of dynamic electricity, produced by steam-power, to the purposes of electrometallurgy, and, in particular, to the deposition of metals, appears to have been introduced into the industry at a date much earlier than that often assigned to it by writers on this subject.

After Faraday had shown that induced electric currents could be generated by the mechanical movement of coils of wire between the poles of either a permanent magnet or of an electromagnet excited by a voltaic battery, various inventors produced special forms of machines. Faraday himself described several forms of magneto electric machine, and Pixii, of Paris, constructed others, of which the first generated alternating currents; while a later form had a commutator to reverse the currents, and render them suitable for chemical purposes. Subsequently other forms of greater power were produced by Saxton, Sturgeon, and Nollett. Woolrich, of Birmingham, seems to have made a remarkable advance in the useful application of such machines. In the "Manual of Electrometallurgy" of the late Mr. G. Shaw (published by E. C. Osborne, of Birmingham, in 1844), there occur the following records:—

(p. 15.) "Mr. Woolrich has succeeded in applying the magneto-electric current to the reduction of metals, a discovery which promises to be of greater importance than any with which the art has hitherto been enriched."

(p. 57.) "Mr. Sturgeon appears to be the first who deposited metals by this apparatus, but his experiments were on a small scale, and it is to Mr. J. S. Woolrich, of Birmingham, that the art is indebted for the perfection of the magneto-electric apparatus, and the development of its extraordinary power as an electro-metallurgical instrument."

"Mr. Woolrich constructs machines after two models; one resembles to a considerable extent, that of Mr. Saxton, and is used where a moderate amount of work is to be performed, and the other is a modification of one of the early magneto machines; this latter form is employed where large quantities of electric power are required."

After describing both these forms, and giving pictures of them, Mr. Shaw states that the small machine, making 1,000 revolutions per minute, deposits 120 ounces of silver per week, and that the larger machine, making 650 revolutions per minute, deposits from 300 to 400 ounces of silver per week. He then contrasts the great expense inevitable, in the use of voltaic batteries for depositing zinc, and the commercial gain in depositing by means of the machine, in which the expense "is limited to the power required to produce the rotation of the armature," and in paying for the wear and tear of the axis in its bearings, and of the contact springs. He then concludes (p. 64): "The uniformity of the current developed in the magneto-electric machine is not the least of the many advantages this machine possesses. In the best constant battery the quantity varies during the course of several hours, and even the best operators, with the battery, find it necessary to give close attention to the state of the instrument and the progress of the deposition. With the magnetic machine the deposition goes on with extreme regularity; and, when once adjusted, may be left for any length of time without fear of derangement. So accurately is the deposition by this machine proportioned to the time of working, that, in an establishment in Birmingham where this process is extensively employed, the quantity of metal deposited is estimated by the time during which the machine works; repeated weighings having demonstrated that the relation between the time of working and quantity of deposited metal, is sufficiently accurate.

Watt's "Electrodeposition" also mentions Wool-

rich's machine, the date of which is 1842. The original large machine is now the property of the Birmingham City, the industry of which it helped to build up.

A still more interesting step in the development of electric machinery is mentioned in Napier's "Manual of Electrometallurgy" (R. Griffin and Co.), 1857, where, on page 46 we find the statement that "this means of obtaining the electricity for the purposes of electro metallurgy has recently been much improved by forms of magnets, &c., patented by Mr. Millward, and described by him as follows:—'The first branch of the improvements is carried into effect by the employment of an electro-magnet, formed by a current of electricity produced from a magneto-electric machine, instead of that generated in a voltaic battery.'" The use in machines of an electro-magnet excited by a battery had, it is true, been foreshadowed by Faraday; and Wheatstone had, in 1845, patented the substitution of a "voltaic magnet" for a permanent magnet. But Millward's invention carries the development one stage further. For while the electro-magnet in Wheatstone's (and Faraday's) machine was separately excited by the currents from a battery, the thing described by Napier is a separately excited electro-magnet, separately excited by means of the currents from a magneto-electric machine having permanent magnets.

One cannot read these early treatises of Napier and Shaw without being struck with their clear recognition of the fact that the real agent in the generation of these currents was dynamical power. Mr. Shaw, who died a few years ago, was a well-known chemist and patent agent.

Woolrich's machine was an object of much interest in the Birmingham Electrical Exhibition, a dozen years ago.

BRITISH FORESTRY.

The report of the departmental committee appointed last February (see *Journal*, vol. l., p. 428) to inquire into the present position and future prospects of forestry has been published as a Parliamentary paper. The present departmental committee endorse the conclusions of the Select Committee of 1885-87 as regards the neglected condition of forestry in Great Britain, the possibility of improvement, and the necessity for the provision of better means of education. As regards the question of the extension of the forest area, the committee point out that there is on the highest authority in these islands an area of waste, heather, and rough pasture, or land out of cultivation, amounting to 21,000,000 acres, on a large proportion of which afforestation could be profitably undertaken. The committee believe that the importance of afforestation in such a district as the Highlands of Scotland will be readily grasped. The area of waste land which might be afforested becomes a matter of grave national concern, when it is remembered that according to exports, the world is rapidly approaching a shortage of, if not actual dearth in, its supply of coniferous timber, which constitutes between 80 and 90 per cent. of the total British timber exports. The committee do not feel justified in urging the Government to embark forthwith upon any general scheme of State forests under present circumstances, but believe that the question of planting suitable waste lands under the control of the Crown, or over which the Crown exercises manorial rights, is worth the attention of the Commissioners of Woods and Forests. Dealing with the question of education, the committee state that, even where access may be had for purposes of instruction to private woods, it is exceedingly desirable that collegiate instruction in forestry should be illustrated by means of example plots, a total area of 100 to 200 acres at each educational centre being necessary and sufficient for this purpose.

The recommendations of the committee are:—

"(*a*) That two areas for practical demonstration be acquired, the one in England and the other in Scotland, of not less than 2,000 acres, if possible, nor over 10,000 acres in each case. We suggest that the Alice Holt Woods in Hampshire be made available as soon as possible to serve as a demonstration area in England; and that a suitable estate be purchased in Scotland, as convenient as possible to Edinburgh, for the same purpose. These recommendations would have to be carried out by arrangement between the Commissioners of Woods and Forests and the Board of Agriculture; and assistance should be looked for from local authorities, societies, and individuals interested in forestry and technical education.

"(*b*) That additional facilities for instruction be afforded, by the appointment of a lecturer on forestry in connection with each of the Universities of Cambridge and Oxford, and that example plots be provided in connection with each of these centres and with Edinburgh.

"(*c*) That a good grounding in forestry form an integral part of the curriculum of the colleges providing instruction in agriculture in Great Britain; and that short courses of instruction suitable for the requirements of young foresters be also provided there. Instructors should also be available for giving practical advice in connection with the management of woods, the owners of which desire an expert's opinion.

"(*d*) That provision be made for the education of foresters and woodmen by employing students to work in both the demonstration forests; and that suitable buildings be erected on the ground for the instruction, and, where necessary, for the accommodation of these student-foresters.

"(*e*) That lectures be given, under the auspices of the county councils, in neighbourhoods where there is a considerable area under wood; and that scholarships be offered in such counties to enable working foresters to attend courses of lectures.

"(*f*) That the inequality shown to exist in the levy of the estate duty on timber be redressed.

"(g) That the Government be urged to secure the early enactment of a Bill to protect owners of woods against loss by fire caused by sparks from locomotives.

"(h) That the inquiry conducted in 1895, concerning the area of woodlands, be repeated by the Board of Agriculture, and that details concerning the character of the timber crop grown upon them be ascertaiued.

"(i) That the attention of corporations and municipalities be drawn to the desirability of planting with trees the catchment areas of their water supply."

Correspondence.

THE METRIC SYSTEM.

Allow me to make a few remarks on the discussion that followed the reading of my paper on Wednesday last.

Sir Guilford Molesworth "did not agree with me that the English system of currency was the best," but "he considered that a change in our currency was not desirable at present;" therefore, as far as Sir Guilford is concerned, the discussion on this subject is purely academical, and of no immediate moment. He says further: "In the measurement of length the millimètre was the practical standard" (surely not for all trades), which was 1-32nd (full) part of an inch, and then he gives a number of values which are mere approximations; and yet further on he, himself, complains that, "under our system workmen use such phrases as 'three thirty-seconds of an inch bare,' which is wanting in exactitude. On the other hand, with the millimètre there was great accuracy." If he were to consent to the creation of the "new inch," he could substitute perfect accuracy for rough approximations, thus instead of his above given value of the millimètre, which is ·00812 of an inch short of the truth, he could say: 1 mm. = ·04 of a "new inch." I repeat that the whole alteration required is the reduction of the size of our inch by a quantity less than one-sixtieth of the "old inch."

Mr. Dowson told us that the late Professor Fitzgerald suggested this identical division in 1896. I wish to thank the speaker for that information, and to assure him, that if I had been aware of the fact I would gladly have quoted the professor in support of my suggestion. The idea was, so far as I know, first mooted by Mr. Gregory, of Manchester, at a discussion on the metric system, held at the Trocadero, in Paris, at the exhibition of 1878. All I did was to work it out more fully. Mr. Dowson desires to "render compulsory the adoption of the metric weights and measures." I anxiously deprecate compulsion being applied to the English people; they will not stand it. Does Mr. Dowson remember that England was the last of the Protestant nations to adopt the Gregorian calendar, and that this innovation was accompanied by wild riots? And yet this did not touch the people's pockets, nor interfere with their daily, ingrained habits. Gently, gently! is the word. "Chi va piano, va lontano," says the Italian proverb.

Colonel A. Cunningham wishes to decimalize our money fully, but he is in doubt, whether he is to decimalize from the halfpenny upwards, or from the sovereign downwards.

If we decimalize from the halfpenny upwards, we must part company with the sovereign, which, as he himself seems to imply, would be a national loss. This coin enjoys a world-wide recognition, as no other money does. So important is its value in the eyes of foreign nations, that Germany has coined a 20-mark piece, which is very nearly equal to the English pound, and Napoleon III. would also have introduced a 25-franc coin (an "empereur") if the war of 1870 had not put an end to his rule.

If we decimalize from the sovereign downwards, we reduce the purchasing-power of the penny by four per cent., which would be a disaster, horrible to contemplate. Fifty times a day the poor man would think himself defrauded; the penny enters into all the arrangements and plans of his life; wages are reckoned at pence per hour; untold numbers of articles are sold at 1d. or 2d. per piece; railway and omnibus fares are paid in pence and so on. Add to this the loss to the Post-office and to the Inland Revenue on the penny stamp, which would have to be made good by the overburdened taxpayer; and finally the all but total loss of the indispensable binary sub-divisions, and all this is to be endured for the sake of a mere symmetry, which is more apparent than real. In one word, the sovereign we should not, and the penny we must not change.

Mr. R. Duppa Lloyd "took the stand, founded upon Blackstone, that Parliament had no right to interfere with the weights and measures," &c. If I may be allowed to substitute "senatus" for "populus," I can answer him conclusively in the words of Cicero: "male judicavit senatus, at judicavit; non debuit, at potuit." In fact, Parliament can do almost anything, except alter the law of gravitation, or the products of the multiplication table, and the like.

A. SONNENSCHEIN.

Wandsworth-common,
January 24th, 1903.

MEANS OF DEFENCE IN THE STRUGGLE FOR LIFE AMONG ANIMALS.

Among *Lepidoptera*, besides members of the *Pieridæ*, the Red and Yellow Underwing Moths are the species I have oftenest observed showing mutilation of the hind wings. Taking the enormous wing area possessed in general by *Lepidoptera*, may we not assume the same to be a means of defence against the attacks of birds. A butterfly or moth suffers the loss of a portion of its posterior wing-

surface without thereby much affecting its powers of flight; in short, it saves its vital portions at the loss of a little superfluous membrane.

G. H. PUDDOCK, F.Z.S.

Mill Bank, Wellington, Salop.
January 26th, 1903.

General Notes.

THE IMPERIAL CORONATION DURBAR. — The names of seven gentlemen who, in recent years, have contributed valuable papers to the Society's Indian Section, are included in the list of honours bestowed by His Majesty the King-Emperor upon the occasion of the Coronation Durbar at Delhi, viz.:—*Knight Commanderships of the Indian Empire:* Charles Lewis Tupper, "Study of Indian History" (1891), "India and Sir Henry Maine" (1898); Herbert Thirkell White, "Upper Burma under British Rule" (1893); Walter Roper Lawrence, Private Secretary to the Viceroy, "Kashmir: its People and its Products" (1896). *Knight Bachelorship:* Dr. George Watt, "The Economic Resources of India" (1887). *Companionships of the Indian Empire:* Professor Jagadis Chundra Bose, "The Promotion of the Advanced Study in Physics in India" (1897); Thomas Jewell Bennett, "The Past and Present Connection of England with the Persian Gulf" (1902). *Kaisar-i-Hind Medal* (1st class) "for Public Service in India," John Nisbet, "Railways in Burma, and their Proposed Extension across Yunnan" (1899). Of other readers of papers before the Indian Section since 1877, some eighteen or more have either received new decorations or been promoted in the orders of which they were previously members; upon another was conferred the dignity of a baronetcy.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock:—

FEBRUARY 4.—"Methods of Mosaic Construction." By W. L. H. HAMILTON. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I.. will preside.

FEBRUARY 6 (FRIDAY).—Adjourned discussion on MR. DIXON DAVIES'S paper on "The Cost of Municipal Trading." The LORD CHIEF JUSTICE, G.C.M.G., will preside.

FEBRUARY 11.—"The Port of London." By Dr. B. W. GINSBURG. ALDERMAN SIR JAMES THOMSON RITCHIE will preside.

FEBRUARY 18.—"Three-Colour Printing." By HARVEY DALZIEL. CARMICHAEL THOMAS will preside.

Dates to be hereafter announced:—

"Existing Laws, By-laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions." By T. BRICE PHILLIPS. (Fothergill Prize Essay.)

"Oil Lighting by Incandescence." By ARTHUR KITSON.

"The Use of Electrical Energy in Workshops and Factories." By ALFRED C. EBORALL, M.I.E.E.

"Modern Bee-Keeping." By WALTER FRANCIS REID, F.C.S.

"Tonkin, Yunnan and Burma." By FRED. W. CAREY, late H.B.M.'s Acting-Consul at Szemao, China.

"Education in Holland." By J. C. MEDD.

"Preservation of the Species of Big Game in Africa." By E. NORTH BUXTON.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock:—

FEBRUARY 26. — "Gleanings from the Indian Census." By JERVOISE ATHELSTANE BAINES, C.S.I.

MARCH 12.—"The Currency Policy of India." By J. BARR ROBERTSON. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

APRIL 23. — "The Province of Sind." By HERBERT MILLS BIRDWOOD, C.S.I., M.A., LL.D.

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 or 5 o'clock:—

FEBRUARY 10, at 5 p.m.—"Women in Canada." By the COUNTESS OF ABERDEEN. The RT. HON. LEONARD H. COURTNEY, M.A., LL.D., will preside.

MARCH 3, at 4.30 p.m.—"The Uganda of To-day." By HERBERT SAMUEL, M.P. Sir HARRY H. JOHNSTON, G.C.M.G., K.C.B., will preside.

MARCH 31, at 4.30 p.m.—"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo.

MAY 5, at 4.30 p m.—"The Lagos Hinterland: its People and its Products." By MAJOR J. H. EWART.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock.

FEBRUARY 3. 4.30 p.m.—"Technical Education in connection with the Book-producing Trades." By DOUGLAS COCKERELL. Prof. WILLIAM GARNETT, M.A., D.C.L., will preside.

FEBRUARY 17. 8 p.m.—"Heraldry in Decoration." By GEORGE W. EVE, A.R.E. LEWIS FOREMAN DAY will preside.

MARCH 17. 4.30 p.m.—"Artistic Fans." By MISS HANNAH FALCKE. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

MAY 19. 4.30 p.m.—"The Mounting of a Play" (Stage Costumes and Accessories). By PERCY MACQUOID, R.I.

Messrs. James Powell and Sons have kindly invited the Applied Art Section to visit the Whitefriars Glass Works, Tudor-street, E.C., on Tuesday evening, April 28th, from 7.30 to 10.30 p.m. A short paper on "Modern Table Glass" will be read by Mr.

Harry Powell, and the processes of glass blowing will be explained in the glass house. The number of visitors will be limited to 100. Further particulars will be announced later on.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

JULIUS HÜBNER, "Paper Manufacture." Four Lectures.

LECTURE I.—FEBRUARY 2.—History—Cellulose—Raw materials—Boiling, washing, breaking, and bleaching of rags—Esparto—Straw.

LECTURE II.—FEBRUARY 9.—Soda recovery—Manila hemp—Jute and other raw materials—Mechanical wood pulp—Wood cellulose—Beating—Sizing—Loading—Colouring.

LECTURE III.—FEBRUARY 16.—Stuff-chest—Regulator — Sand-tables — Strainer — Hand-made paper—Fourdrinier paper machine.

LECTURE IV.—FEBRUARY 23.—Single cylinder and other types of paper-making machines—Finishing — Cutting—Statistics—Paper-testing—Experimental paper making.

MEETING FOR THE ENSUING WEEK.

MONDAY, FEB. 2...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Julius Hübner, "Paper Manufacture." (Lecture I.)

Farmers' Club, Salisbury-square Hotel, Fleet-street, E.C., 4 p.m. Mr. Orlebar, "County and Local Agricultural Societies."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Inaugural address by the President, M. J. Patten Barber.

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. F. Evershed, "Statistics of British and German Chemical Trades for 1901, with suggestions for improving the Official Tables." Mr. H. Droop Richard, "The Standardisation of Analytical Methods."

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Professor Lionel S. Beale, "The Unseen Life of our World, and of Living Growth: Design, Human, and Divine."

British Architects, 9, Conduit-street, W., 8 p.m. President's Address to Students.

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. Kaines Smith, "Cyprus."

Anglo-Russian Literary Institute, Imperial Institute, South Kensington, S.W., 3 p.m. 1. Mr. W. Macnab, "Jean de Bloch." 2. Miss Phibbs, "Finland."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. E. W. Maunder, "The Royal Observatory, Greenwich."

TUESDAY, FEB. 3...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Applied Art Section.) Mr. Douglas Cockerell, "Technical Education in connection with the Book-Producing Trades."

Royal Institution, Albemarle-street, W., 3 p.m. Professor Allan Macfadyen, "The Physiology of Digestion." (Lecture IV.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on papers by Mr. Maurice Fitzmaurice, "The Nile Reservoir, Assuan," and Mr. Frederick Wilfrid Scott Stokes, "Sluices and Lock-Gates of the Nile Reservoir, Assuan."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Dr. W. Kidd, "The Hair-slope of four Typical Animals." 2. Capt. F. Wall, "A Prodomus of the Snakes hitherto recorded from China, Japan, and the Loochoo Islands." 3. Mr. H. J. Elwes, "The Variation of the Elk." 4. Mr. R. Lydekker, "Note on the Wild Sheep of the Kopet Dagh."

WEDNESDAY, FEB. 4...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. W. L. H. Hamilton, "Methods of Mosaic Construction."

Geological, Burlington-house, W., 8 p.m.

Archæological Association, 32, Sackville-street, W., 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m. Annual Meeting.

Royal Archæological Institution, 20, Hanover-square, W., 3 p.m. Dr. Alfred C. Fryer, "Fonts with Representations of the Holy Eucharist and Baptism."

THURSDAY, FEB. 5....Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Prof. F. W. Oliver, "*Stephanospermum*, Brongniart, a genus of fossil Gymnospermous Seeds." 2. "Median Prolification in *Geum rivale*, illustrated by specimens from the Herbarium of Sir J. E. Smith, and other sources."

Chemical, Burlington-house, W., 8 p.m. 1. Mr. J. S. Lumsden, "A New Vapour-density Apparatus." 2. Mr. J. S. Lumsden, "A New Principle for the Construction of a Pyrometer."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. J. A. Steuart, "The Confessions of a Novelist."

Society for the Encouragement of Fine Arts, 6½ Suffolk-street, S.W., 8 p.m. Mr. Edgar F. Jacques, "The Music of Oriental Nations."

Royal Institution, Albemarle-street, W., 3 p.m. Sir Clements Markham, "Arctic and Antarctic Explorations." (Lecture I.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Adjourned discussion on the Metric System.

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. Alphonse Steiger, "A Description of a few of the most recent Water Turbine plants in Great Britain and Abroad."

FRIDAY, FEB. 6...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Extra Ordinary Meeting.) Adjourned discussion on Mr. Dixon Davies' paper, "The Cost of Municipal Trading."

Royal Institution, Albemarle-street, W., 8 p.m. Weekly meeting. 9 p.m. Sir Herbert Maxwell, "George Romney and his Works."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper on "Pavements."

Geologists Association, University College W.C., 7½ p.m. Address by the President, "The Recent Geological History of the Bergen District of Norway."

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Architectural Association, 9, Conduit-street, W. 7½ p.m. Prof. G. B. Brown, "What is the Real Value of Greek Work to the Modern Artist?"

SATURDAY, FEB. 7...Royal Institution, Albemarle-street, W., 3 p.m. Mr. A. B. Walkley, "Dramatic Criticism." (Lecture I.)

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FRIDAY, FEBRUARY 6, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, February 9, 8 p.m. (Cantor Lectures.) Julius Hübner, "Paper Manufacture." (Lecture II.)

Tuesday, February 10, 5 p.m. (Colonial Section.) The Countess of Aberdeen, "Women in Canada."

Wednesday, February 11, 8 p.m. (Ordinary Meeting.) B. W. Ginsburg, M.A., LL.B., "The Port of London."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 2nd inst., Mr. Julius Hübner delivered the first lecture of his course on "Paper Manufacture."

The Lectures will be printed in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday, February 3, 1903, 4.30 p.m.; Professor William Garnett, M.A., D.C.L., in the chair. The paper read was "Technical Education in connection with the Book-producing Trades" by Douglas Cockerell.

The paper and report of the discussion will be published in a future number of the *Journal.*

Proceedings of the Society.

INDIAN SECTION.

Thursday, January 22, 1903, 4.30 p.m. The Lord Harris G.C.S.I., G.C.I.E., in the chair.

The paper read was—

DOMESTIC LIFE IN INDIA.

By John David Rees, C.I.E.

It was the often-quoted Marcus Aurelius who said, "Improve things a little, and do not consider such a result of small importance," and it is only with some such maxim in his mind that anyone more or less familiar with Indian manners, customs, and languages can venture to address an audience like this on such a subject as domestic life in India. It is so vast a theme, and admits of so many aspects, that nothing but a conviction that the aspect most perseveringly offered to the English public is unjustified of the facts would support an individual in his endeavour. That India is a continent occupied by many races speaking many languages is a fact only imperfectly appreciated in England, and it may easily be imagined that women within its borders differ in different parts of the Empire as much as the hardy and laborious housewife in Finland differs from the ease-loving and lazy daughter of Southern Italy, and that their homes exhibit no less variations from what may be considered the standard type.

But as a common Christianity imposes standards possessing some similarity in their ideals, if not in practice, upon all the inhabitants of Europe, so does the Hindu, the caste or the Brahminic system conduce to the acceptance right throughout the wide extent of the Indian empire of common standards of life and conversation. It would be extremely easy to show the wide variations from this caste Hindu standard which obtain among many tribes, races, classes, and sects, but throughout all these variations, even where certain customs absolutely repugnant to Hindu ideals exist, the scheme of life upon the whole will be found to be fashioned upon that of the caste Hindu or Brahminic system.

It is as well at the outset to realise that Hinduism is caste, and caste is Hinduism.

The terms are, in fact, of equal value and significance. The 1901 census reports of various provinces, which have just been received, are the latest and most authoritative accounts of the present condition of different parts of the Empire. The superintendents, able men selected for this duty on account of their special qualifications, when they have to define Hinduism in the interesting chapters relating to religion, agree in saying that so long as a man observes caste rules, he may not only do pretty much as he pleases, but may actually offer his individual worship to any god or hero, any stick, stone, river, hill, or natural feature, which his own inclination, or the animistic traditions of his village have endowed with supernatural attributes of a protective or destructive character.

This is no discovery, but it is probable that even in this hall the audience which recently heard a distinguished Indian gentleman describing caste, which he had abandoned, as the root of all evil, hardly realised that caste is Hinduism, that to condemn it is to condemn our Indian fellow subjects, to actively work for its destruction is to run counter to Queen Victoria's proclamation of 1858, and the solemn pledge it contained to guarantee to the natives of India their own customs and their own religion. An accomplished Bengali author, Mr. Ghose, recently published the life of Maharaja Nabkissen, a friend of Clive, who helped us in our early days in India, more, perhaps, than we have ever acknowledged. Mr. Ghose sees "in the English conquest of India, more than in any other event of equal importance, a divine dispensation." The founder of the Brahmo Samaj, Keshab Chunder Sen, whose new religion was a revolt against caste, the most binding law of which he none the less observed in his family life, used much the same language, but without adding, as Mr. Ghose does, that there is no fear of our rule going wrong, if we remember the principle of Queen Victoria's charter, and if in carrying out innovations we follow the English method, not of revolution, but of evolution.

Our legislatures in India have none the less, since the precedent of the abolition of *Sati*, with which no other Indian customs can compare, passed Acts which are revolutionary in character, and might have tended in some measure to produce discontent, but that they have fallen stillborn from the legislative womb, like the untimely fruit of those premature marriages, against which reformers, not indeed without reason, if without measure, rail, but which, as a rule, they practise in their own family circles.

These remarks are merely introduced for the purpose of showing that the Hindu domestic life is a caste life, of which indeed we are all entitled to hold and express our opinions, but from endeavouring to destroy which, we are precluded by a sacred engagement. An anti-caste attitude is an anti-Hindu attitude, and if it provokes discontent and reprisals, we have no more right to resent such manifestations, indeed we have far less right, than we have to complain of criticisms and condemnations of ourselves and of our methods, which we do not altogether appreciate, and indeed do not deserve, on the part of our European neighbours.

It is necessary then, in looking at a representative Hindu family, to look at its caste aspect, remembering that, while domestic life differs in many parts of India from these standards, they are the ideals to which all respectable and self-respecting families approximate, or which they will consciously or unconsciously aspire to imitate.

The South of India and the Deccan is that portion of the continent in which Hinduism may be studied with the greatest advantage. Mohammedan rule and customs herein never took root. Even in Hyderabad the people are Hindus, and the Mussulman lords and their followers a mere handful, while on the south-west coast there are Native States, which are completely unaffected by the Mohammedan conquest, cut off as they are by the sea and the mountains from all invasion, and from all foreign influences.

The extent, however, to which Mohammedan customs have affected other parts of India is habitually over-estimated to an enormous and unpardonable extent. It is as easy to overrate this effect as it is difficult to exaggerate the influence Hinduism has had upon Islam in India.

To take a Hindu home in a village in Southern India, the anglicized Hindu's house in the Presidency city being hardly more representative than that of the foreign immigrant. In the first place, the site must be chosen and the house built according to caste rules and the science of domestic architecture; and there are auspicious months in which to build in India, just as in England in which to marry. In rich houses the chief entrance is called the lion gate—like one of the gates of Kew Gardens—and it is sometimes elaborately carved. The beams and posts are apostrophised,

hymns are chanted, saffron, turmeric, and sandal are smeared upon them, flowers are offered, and whether, in fact, the ceremonies are looked upon as differing very widely from our deposit of coins and newspapers, speech-making, and trowel presenting, no one can say. It is enough that custom prescribes certain ceremonies. The house, and the mere hut follows suit, is one or more quadrangles with one or more open courtyards, and sun and rain must have access—a good rule, and one which would be better if there were but added a drain. A blank wall is offered to the street, and around the inner quadrangle runs a verandah, to the south-west of which is the kitchen. In marked contrast with the dark and impenetrable annex to the luxurious bungalow of the Anglo-Indian, in which an utterly casteless cook prepares in some absolutely and fortunately unexplained manner an excellent, but, to the caste Hindu, unmentionable dinner, the kitchen is the most sacred part of the house, and, in fact, combines the characteristics of a chapel and a cook house. A Christian place of worship may be smaller and lower than the house of the owner in India, as in England the tower of the house may top the spire of the church, but in an Indian house no part should properly be higher than the kitchen, into which no person of lower caste than the owner may so much as look, far less enter. A Brahmin may cook for a master of lower caste who pays him, but if his master looked inside his kitchen, in such a case the Brahmin would not touch the food. The bed and other rooms open into the inner verandah, in which cows and calves are also often stabled. No Christian should take fright at this custom at any rate, and different as is their religion, the home life of the Hindus repeatedly recalls and illustrates the Bible narrative of the origin in Asia of our own religion. Of furniture there is little, and when a Hindu has a grand home after the Western fashion, the furniture of the apartments he actually uses consist of pots, and pans, and brazen vessels, and possibly a chair or two, and a simple bedstead, called the "fourlegs," with broad webbing, which is really as comfortable as any which Maple or Hampton can supply. The married sons generally live under the paternal roof, which is very elastic, as any male can sleep anywhere on the floor. This sounds uncomfortable, but a bed a head is by no means the rule all over Europe. Indeed in Russia men servants often sleep about anywhere in great houses, and even guests in country places. There are sometimes a few flowers, and always an altar containing a shrub of sacred basil. The houseowner does not get installed without a good deal of ceremony, and a certain amount of expense, which corresponds, perhaps, with our house warming.

Let us, following the principle above enunciated, suppose him to be a Brahmin, and at length installed. He must rise before the sun and pass some time in contemplation, repeating to himself texts from the Puranas :

> "Rama! thou givest all good things,
> Who, but thyself, deliverance brings,
> Thee with one voice we all adore.
> Ah! let me praise thee more and more."

Then follow rinsings of the mouth, washing of the feet, cleansing of the teeth with a piece of stick never to be twice used—women use the finger—then the bath in river tank or well, next prayers, oblations to the sun, more prayers, the fixing of caste marks on the now purified person, salutations to the different quarters of the compass, oblations in honour of ancestors, and repetition of the sacred Sanscrit text :

> "Hail earth and sky, and heaven, hail kind'y light,
> Illuminator of our purblind sight."

There are more prayers before the midday meal, and these at least are a counsel of necessity, and are attended with further ablutions, the wearing of clean cloths, and more prayers and oblations, bathing of the images of the gods, offerings of clarified butter, flowers, and of a portion of the food. Then the male members of the family sit on the floor, and eat their rice or other grain with pickles or condiments, off plates made of plantain, or other leaves. Food is eaten with the right hand, and water poured from a vessel held in the left hand right into the mouth, neither vessel nor water touching the lips. The latter must have been drawn and fetched from the well by a person of good caste. There is a great prince in India who can only drink water given to him by a particular Brahmin, and once he suffered greatly when this necessary and important functionary was unavoidably delayed on his way to the palace.

Very much the same prayers are repeated at eventide, but the gods are not again bathed and worshipped before the evening meal is taken, about the same time as the supper, which in our artificial life, with its injurious and unnatural late hours, it pleases us to call dinner—a term more usually applied under

simpler conditions to the midday meal. These prayers and ceremonies are really less long and irksome than might appear, and on journeys and during illness they are necessarily abbreviated. There is no custom of regularly visiting the temple, corresponding with our habit of going to church, though worship is performed by the officiating priests daily, without fail, as in one branch, at any rate, of the Christian Church. Upon holidays and festivals, however, people worship the gods in the temple with flowers and fruit. As for the women, they should worship their husbands, and, in company with their husbands, the gods, but the production and nurture of children and the care of domestic affairs is their peculiar sphere. It is probable that women, who confine themselves to these two duties, are not inferior to others whose energies are more divided. At any rate, Hindu literature and history affords frequent examples of heroines, who would do credit to any clime or country, and who were honoured by their own people with every mark of extravagant affection and esteem. Sita, the wife of Rama, is the Indian Penelope, and allowing for poetic and traditional exaggerations, her standards of life and conduct are such as Indian women very generally maintain—

> "As the shadow to the substance, to her lord is faithful wife,
> And she parts not from her consort, till she parts with fleeting life."

And women have in fact their daily prayers, translations of which I myself made for Queen Victoria, and a wife is a necessary part of certain ceremonies performed by her husband. In daily life, she rises before him, cleans the house, and particularly the kitchen, singing hymns the while. Next she bathes, and puts on her forehead the mark of her married state. Cooking occupies her till midday dinner time, and before her own meal, which follows after that of the men, she says a simple prayer accompanied by prostrations, offerings, bell ringing, and circumambulations of an image, perhaps of the goddess Lakshmi. Of course, in the cultivating classes, women help freely in field labour. At night again when the lamps are lit, she makes obeisance to the god of fire, saying:—

> "This flame proceeds from God above,
> This lamp is lit by heavenly love;
> So praise we, when each night begins,
> The fire flame which burns away our sins."

I hope and believe that good Hindus will forgive my rough rhyming translations of their sacred Sanscrit texts, in consideration of the respect I have for their lives and their characters. As to the worship just described, I have seen the head of the house in holy Russia go though almost identically the same ceremonies before the eikon in the angle of the wall, and except that he knows he is "orthodox" and no one else is, which is exactly what the Hindu thinks, I doubt if his religious beliefs are necessarily of a higher order. At any rate, assassins have prayed to eikons for success in their undertakings, and if Thugs in India did the same, they were no more representatives of true Hinduism than the worst of its orthodox children are of the Greek Church.

One of the greatest authorities on the Hindus, Ward, says that "a husband may enjoy heaven as the fruit of his wife's virtuous deeds, and if he die first will suffer for the sins of his wife," in short, their good deeds are transferable, but the Hindu authorities of the present day are not very clear on the point whether a good husband can save a bad wife. All agree that after her husband's death she can hasten his final absorption into beatitude by her prayers and penance, a doctrine apparently not widely distinguishable from that of the elder branch of the Christian Church, which Hinduism also resembles in its more rigorous fasts. This is pure Hindu doctrine, and the lower we descend in the scale the less provision is there made for women's rights, in this world and the next. In the lower castes the actual worship is rather demonolatry or animism, where daily ritual amounts to little more than an obeisance to the sun in the morning and the lamp at night, except during epidemics and festivals, when the idol in the temple, or the fetish in the field or beneath the tree, is propitiated with offerings of fowls, fruit, food, or flowers. In the people of India a belief in transmigration co-exists with the creed that during one life the individual is unconscious of a former existence, which must largely discount the value as a penance of a term spent in the guise of an unclean or unfortunate animal. In fact, it is no part of the theory of transmigration that any such consciousness exists. To the inquiring European Hindus are shy of communicating much information on this subject.

The Hindus, though they present a solid front to non-Hindus, are divided themselves into Nondualists, believing nothing has any real separate existence from the one God, Dualists, who allow that the human soul and the material world have a distinct existence, and the Non-

dualists, who yet ascribe to the Deity a form and quality, giving him a twofold aspect—the Supreme Spirit the cause, the material universe the effect. While these distinctions interest the learned, ordinary people are content to worship Siva or Vishnu, the latter cult having more than one sect. All this recalls the vain disputes which centred round the ὅμο and the ὁμοιόουσια. Unfortunately the course of study at our colleges and universities includes and encourages philosophy, so that not a little harm is done by confirming the tendency of Hindu youths to waste their time in studying vague problems, such as learned triflers were wont to waste their time in discussing in Europe. The outward and visible signs of the sects are a trident for Vishnu, and one or more horizontal lines for Siva, and without these marks food must not be eaten nor acts of worship performed. The wife generally wears a red spot upon her forehead. Had the Christian missionaries allowed converts to retain these marks, the topknot, and other signs and observances of caste, the conversion of the country would have more nearly approached the region of possibility. The Roman Catholic missionaries, who led off with great successes, saw this, and so long as the controversy known as that of the Malabar rites was not decided, against what the purists called trifling with idolatry, they had a fair hope of the wholesale conversion of the extreme south, at any rate of India, on the west coast of which there are still some, and they are practically all the, high caste native Christians, who retain for the most part their caste, and a corresponding position in Hindu society. The English might have passed for a high caste, with all its inestimable social and political advantages, had they not, apparently, made a point of engaging Pariahs as their servants. All Indian questions are caste questions, and these are matters of the first importance. No Englishman who turned Hindu would be accepted as an authority, even by Hindus, regarding the religious and social characteristics of the people he had forsaken, if indeed he got a hearing at all. Mrs. Besant does not lecture to Hindus on Christianity, but on Hinduism; but here, in England, the authorities accepted of the public and the press are generally those who having been, have ceased to be, Hindus. In such cases were they angels from heaven they could hardly be other than steeped to the lips in prejudice. Is not an ancient civilisation entitled to a fair hearing, a faith professed by millions to respectful treatment, a law-abiding and loyal people to an unprejudiced judgment? Yet they often fail to obtain bare justice, and are condemned offhand on an individual, and necessarily interested, representation.

Controversy rages around the marriage of the most married peoples upon earth. Whether or not and to what extent maidens chose their own husbands in Vedic times is a matter of little importance; their parents now choose for them, as is done, it may be observed, in most European nations, though not in England. Although girls need not be married till they are of a marriageable age, the absolute necessity among Brahmins and their imitators of finding a husband of the right caste or division of caste before the girl reaches that age, leads to their being betrothed when small children, the betrothal being a binding ceremony. The advice given in the institute of Manu is often quoted:—

"Let a man not marry a girl with reddish hair, or deformed limb, nor one troubled with sickness, nor one with too much or too little hair, nor one immoderately talkative. Let him choose a girl whose form has no defect, who has an agreeable name, who walks gracefully like a young elephant, whose hair and teeth are moderate in size and quality, and whose body has exquisite softness."

Let those who know the elephant in the Zoological Gardens laugh; those who have watched free herds in their native jungles can see that the sage's eye was not altogether in fault.

Polyandry is rare is India and only practised by a few degraded tribes, for the Nairs of the Malabar coast by no means deserve this reproach. True, a Nair woman can change her husband, but she may not have more than one at a time, nor does she exercise the privilege of making a change without good reason under pain of loss of reputation. Similarly, polygamy is permitted to Hindus, but their instincts are monogamous, and they rarely and regretfully take a second wife, unless the first has no surviving male issue, when the paramount religious necessity for having a son to perform the father's funeral sacrifices, renders an adoption or a second marriage obligatory. Even in that case the first wife should consent, but she is often the first to urge the step, and seeing what her object is, this can only be to her credit. No doubt questions of dowry enter into Hindu marriages; but are they unknown elsewhere? are such negotiations everywhere

based solely on the interests of the young couple?

> "How many a noble father since Agamemnon sinned
> Has sacrificed his daughter to try to raise the wind?"

At any rate, anything like selling a young daughter to an old man for money is not only against the spirit, but is contrary to the letter of the Hindu law, and human nature varies in India as it does elsewhere in brides and bridegrooms and their parents. It will astonish some to hear it, but it is roundly asserted that English education has increased this abuse, since large sums are now offered as dowry for youths who have the degree of B.A. and M.A., who may be expected to secure the coveted post under Government.

The marriage ceremonies are infinitely complex, long drawn and costly, as unduly costly, perhaps, as funeral ceremonies in England, in proportion to the means of those who incur them, but more justifiable, since the occasion is one for rejoicing. Houses are decorated and enlarged with temporary additions, and the ceremonies last about a week. A description of them would not, I think, greatly interest my audience, but they include praying and eating and drinking, and the exchange of presents. When the actual giving of the maiden takes place, the groom is asked if he is willing to take her to wife, and on his assenting, his garment and that of the bride are knotted together. This is a very important symbol, and in Malabar, where marriages are bereft of all the usual attributes, the giving of a cloth none the less is obligatory. The father declares his willingness to give the girl to be the groom's wife, hands are joined, a libation of water is poured, a gold ornament, corresponding with our wedding-ring, is tied around the neck, after which all those present throw coloured rice over the newly-wedded pair, who, with clasped hands, walk three times around the sacred fire. Hymns, of course, are sung, and husband and wife eat together—the only occasion, for subsequently she eats after her husband. There is also a great deal of feasting and a procession, attended with much pomp and music. The bride, who, in the case of rich and respectable families, is never of a marriageable age, remains with her parents till she grows up, and further ceremonies take place when she joins her husband. Among the lower classes and castes there is, unless the family happen to be rich, less ceremony and less feasting, but as far as may be they follow the lead of the Brahmins.

Apropos of feasting, whether or not in the Vedic epoch, the whole animal and vegetable system was available for the sustenance of man as appears from the institutes of Manu to have been the case, the higher classes now are, as is well known, rigid vegetarians. The census reports of 1901, agreeing herein with that excellent authority, Mr. Crooke, attribute the greater strength of Mohammedans and their greater relative increase in numbers, in part at least to their habit of eating meat, but there are excellent reasons for holding that a vegetarian diet, which connotes to a great extent abstention from alcohol, is more wholesome in the Indian climate, and it is fortunate that this is the standard to which the lower classes, who may and do eat meat, when they can get it, are apt to approximate, and still more fortunate that the cow, which gives milk and butter, and the ox, which draws the plough, were declared sacred by the earliest authorities. The Hindu's table, is not, however, badly supplied, and I have myself sat bewildered and wholly unequal to the occasion among a multiplicity of vegetarian dishes of every variety of flavour, astonished at the number of chutnies, pickles, butters, sauces, which are available, all prepared by the ladies of the family, every one of whom is a well qualified stillroom maid.

As with food so with drink. The Hindus have always taken alcohol, but the use of it is looked upon as degrading and characteristic—as it actually is except, perhaps, among the English-educated—of the lower classes. Upon the whole, it may be said that temperance is as distinguishing a mark of the Hindus as intemperance is of certain European nations, though cheap liquor is easily procurable and the climate is hot and enervating. There is no nation more temperate in its own tastes, and more tolerant of those of others, than the Hindus.

Besides dinner and supper, the recognised meals, with which, polite as he is, the Hindu will hardly suffer other calls to interfere, a light early breakfast of cold rice or cakes is generally taken, when, as always happens with the masses, the early riser gets early to work. Coffee is sometimes taken, and hopes are entertained that a morning cup of tea may become as usual among the people as it is among the Europeans in India. The Hindu traveller suffers much inconvenience in keeping his caste rules, but the ever ready hospitality of the country comes to the rescue. To feed the wayfaring son of the road is a

religious duty. In the Institutes of Manu it is written—

> "Who sends the stranger hungry from his door,
> That stranger's sins are added to his score;
> Who entertains a stranger, though his sins
> Are red as scarlet, he salvation wins."

An attention to sanitary considerations, which in other respects, it must be admitted, is not always present, partly inspires the odium which attaches to Pariahs, who eat carrion. It is because they employ servants of this caste that Englishmen are denied privileges enjoyed by Mohammedans and Hindus of all castes, other than Pariahs, whom, it will be observed, Mohammedans will not employ. The position occupied by the Mohammedans as caste men in the eyes of the Hindus would have been to the English a valuable political asset, which they will now never possess.

It is characteristic of the kindly nature of the Hindus that their new year's festivities extend to the cattle, who are given a rest and a feast. Upon the Naga festival, offerings are made to the cobra, as the king of the snakes, whose worship in one form or another, and to a greater or lesser extent prevails all over India. Indeed, on the Malabar coast, a cobra corner is looked on as one of the amenities of the separate walled-garden houses which usually are found in that favoured region. Upon Ganesha's birthday, the god who removes obstacles, a fat and friendly deity, artizans perform *puja*, or worship the tools of their trades, and students to their books, a very practical form of prayer. During the Durga-puja or Dussera, riots often occur between the Hindus and Mohammedans. In Southern India serious objection was taken to Hindus "putting on appearance of tiger," the man tiger in buff and black stripes being looked on as a special attribute of the Mohammedan commemoration of the martyrdom of the Prophet's grandson, Hussein. I have, myself, had to deal with quarrels arising out of this point of procedure. Every full moon is holiday, and sea bathing with the Hindus, as with us, though we attach to it no religious significance, is considered necessary at certain seasons of the year.

Unfailing charity is a well-known attribute of Hindus, and the comments made two years ago on their subscriptions to the public and semi-official famine funds, took no account of the fact that they were already, and had long been, supporting the famine-stricken to the utmost limit of their means. The Hindu not only supports his relations, but also the poor scholar, for—

> "Heaven's gate is near the sinner
> Who gives the humble scholar dinner."

No doubt their charity is abused, and sturdy beggars presume upon it, but is the administration of our poor-rate free from the same reproach, and is the money compulsorily collected and voluntarily contributed in England, so distributed as to relieve in fairly equal measure those in real want? Both systems are subject to serious abuses, but the spirit underlying that which obtains in India is at any rate worthy of all praise.

There is no need to dwell on the ceremonies which attend the disposal of the dead. The sick man in his last moments if lying on a couch or bed is lifted therefrom that he may die upon the earth or beside the river, after receiving the last sacrament, composed of products of the sacred cow. This practice is founded partly on the necessity which exists for dying on the bosom of mother earth, and partly on the need for avoiding the pollution which attaches to a house in which a death occurs. The chief mourner is son, father, brother, in the order given, or in the case of a woman, her husband, and he performs a sacrifice of fire before the body is borne by the caste fellows of the deceased to the burning ground, where a funeral pyre awaits the corpse, made up in the case of a poor family, perhaps, by contributions of a few sticks from neighbouring houses. The chief mourner takes upon his shoulder a pot of water, and, after walking three times around the blazing pyre, dashes it upon the ground. In the case of castes, who bury their dead, which all do in certain cases, a different ritual prevails, and, as might be expected from lower castes, it is less elaborate than that of cremation. The same distinction applies to the periodical ceremonies for deceased ancestors, which are performed in India, as in China, though in a lesser degree. As a result of such prayers and ceremonies, the spirit of the deceased is provided with a temporary body, and without them it would wander about as a malignant ghost. Next, the temporary body is exchanged for an ethereal envelope, and either passes into the ancestral heaven, there to remain until absorbed into the divine essence, or, as is more widely held, receives judgment according to its works in the world, being reborn after a longer or shorter period spent in the purgatorial heaven or hell, to again accomplish a mortal life in another guise, until at length

it qualifies for Nirvana, or absorption in the supreme essence.

The Hindus believe in a Supreme Being, the immortality of the soul, and the necessity for, and existence of, another life in which sin and virtue meet with their reward.

In the *Sama-Veda* a typical man of sin is described, his head Brahmin murder, his eyes liquor drinking, his face theft, tutor-slaying his ears, woman-killing his nose, cow destroying his shoulders, abduction of another's wife his chest, oppression of the innocent his stomach, while smaller sins are apportioned to the lower limbs. He is tall, bright-eyed, black, and malevolent.

In the Institutes of Manu, the body is compared with a house, in words which may be thus translated—

" Bones are its rafters and its beams,
Tendons and nerves, its scores and seams;
Blood is its mortar, and the skin,
Frail covering, roofs the mansion in.
Its occupants are age and woe,
Death and decay, as sure as slow;
Right gladly should the vital spark,
The soul, renounce a home so dark.

Birds at their pleasure quit the tree,
Who leaves the world alone is free."

Are we to assume, then, that life in the Hindu home is sad and wanting in brightness? By no means. Captain Temple thus described it in the paper he read before this Society, but can those whose tents have often been pitched by the village well agree with him? Let a talented Mahratta lady, Miss Bhor, speak for Bombay, and note what she says of purdah, in passing. The Madras *Hindu's* report runs:—

"It is usual to suppose that Hindu women are everywhere immured in the prison of zenana life, without hope of light or movement, and that they are actually nothing but birds kept in a cage. Their life is supposed to be one round of unrelieved gloom and misery, little better than the lot of old-world slaves, consigned to drudgery and even to solitary confinement in unwholesome dungeons. This figment of an unwholesome and diseased imagination has been repeatedly exposed, but it has lived on and flourished. Miss Bhor boldly tells the truth, and we hope she has killed this dragon of interested falsehood. She spoke thus:—'In those parts of Western India where the Mohammedan invasion very slightly affected the older Hindu customs, the Brahmin and other high caste women neither veil themselves nor live in seclusion; and at parties have as merry time as the men, though they do not mix with them. Women's parties from which men are excluded are often very pleasant. Hindu women and their families often go on pilgrimage as when some member of the family sickens, or a girl becomes morbid and fancies herself possessed by an evil spirit. The journey is a rough but healthy experience, shaking the travellers out of the monotony of their daily lives.' What is true, thus, of Western India is true also of Southern India. Here too we have no veils, nor our women kept in enforced seclusion within a prison-cage. Here, too, women freely move abroad and can be seen in the street, market, river-side, or temple, as cheerful and sometimes even as vocal as any member of the sterner sex, and this, too, not only among the lower but also among the higher classes of society. Miss Bhor says truly that 'on the whole the Hindus are of a kind and cheerful nature which is reflected in their home life.'

"Let us next see what Miss Bhor has to say on the Indian system of child-marriage. We have always spoken candidly on the evils of the system, but even here there is such a thing as moderation and restraint; and Miss Bhor, while condemning the system as mischievous, exercises an admirable caution and good sense which others will do well to imitate. A good cause is often injured by extravagance and violence of language, and ardent minds always become victims of a disordered imagination which see things as through a magnifying glass which distorts the true proportions and creates monsters and hideous shapes out of all relation to the realities around us. Miss Bhor writes as follows:—'The system of child-marriage is bad and brings in its wake worse evils; but given a bad system, it is worked out on the whole in a kind and sensible fashion.' She, again, speaks sensibly and truthfully on the system of compulsory marriage:— 'Though marriage is obligatory on every Hindu man and woman—no choice is allowed to man or woman in the selection of a partner—but it causes less unhappiness on the whole that married girls should be taken to their new homes, &c.' This system of girls being taken immediately after marriage to their new homes prevails only in some parts of India, and even there Miss Bhor says that 'it causes less unhappiness on the whole.' In Southern India, this custom does not prevail. The girls remain with their parents till they grow up and even longer, and so the system of child-marriage loses its darker features a good deal in this part of the country. But we still hold firmly to the conviction that the system is 'bad,' and that it must be improved so that we may return to the old Shastraic institution of marriage after puberty. On this, and cognate questions, Miss Bhor writes very sensibly, and in weighty language:— 'Freedom and choice are not recognised in the Hindu system for women, at all; and for men very slightly. And yet Hindu marriages turn out happy much oftener than might be thought possible in such circumstances, and no doubt in far away ages the system was not meant to press so heavily on women as it does now. Child-marriages were then unknown, &c.'

"Even as regards the question of child-widows, while condemning the institution in strong language, Miss Bhor admits that 'in the working out of this

iron caste system there is much real heart and tenderness which softens for many its cruel decrees.' "

Meadows Taylor thought the Hindus "as courteous and intelligent a people as any in the world; kind to their children, respectful to their parents, charitable, honest, industrious, and with such vices as are common to human nature." He denied that they were untruthful, and saw in "caste the means of enforcing the at least outwardly moral conduct of members."

Dr. Oldfield came back the other day from India, and said with all truth that the village folk were industrious, cleanly, thrifty, and simple in their lives, that the women are engaged in housewifely duties from morning till night.

See, too, how Mr. Dutt, when he soars above the exigencies of the platform, describes "the grateful people of India, their courtesy, frugality, charity; their dislike and distrust of the rapid introduction of modern Western methods; their love of living their own lives, their own way, in their own villages; their dislike of the alienation of their chiefs and rajas, who cease to live and move among themselves and become strangers among their own people." Carried away by this faithful and eloquent description he says, as Mr. Ramakrishna said—"There is not on the whole earth a more frugal and more contented peasantry." Even Abbé Dubois, who takes an unfavourable view of the Hindu character, says—"Animated in this behalf by the purest and noblest sentiments, the Hindus consider a man happy in proportion to the number of children he possesses, children being considered the blessing of a house." Those who have ears for the merits of a multitudinous people should also read what Sir T. Munro, Sir J. Fayrer, Sir J. Malcom, Professor Max Müller, and Sir W. Sleeman say in their favour.

The Dewan of Travancore well says that the Hindu home is founded on the basis of religion, in which a Hindu lives, moves, and has his being. The father is the guardian, preceptor, and patriarch, the woman protected by her male relations, and always married; nor looking at other countries where celibacy is practised by women, can he consider universal marriage altogether a curse. The decay of marriage marked the decline of the Romans and Greeks, and the Dewan would adhere to the high Hindu standard, merely postponing the ceremony till the latest permissible period. "The present system produces wives who in all that goes to the happiness of the husband and the peace of the home cannot be surpassed." "There is great misapprehension," says the Dewan, "among European nations regarding the purdah. There is no slavery or tyranny, and as families rise in the world their females ask for the privilege of the zenana system."

Mr. S. E. J. Clarke, a well-known authority on Indian life, said before this Society seven years ago that Hindu women are distinguished for intense religious feeling, and would deem the freedom enjoyed by English women a degradation, and a wilful abandonment to temptation.

Mr. Padfield, a distinguished writer and authority on Indian life, himself a missionary, says—"Habit and custom are much, if not everything, and certainly many a Hindu home is happy in spite of what may seem to us its dulness and monotony." Mr. Crooke says—"The North Indian peasant's life is one of ceaseless toil, but it enforces industry and temperance, and is compatible with a ready cheeriness, which can find amusement in the veriest trifles. It would be a great mistake to suppose the wife of the peasant to be nothing more than a drudge. Nothing in the house is done without her knowledge and advice, and she is not worse off, perhaps, than her sisters in a similar grade in other parts of the world."

Such as they are, husband and wife, they are likely to remain, unless unforeseen developments occur in the industrial potentialities of the country, for it is curious to find two authorities, neither of whom can well be surpassed, Abbé Dubois and Mr. Crooke, in the beginning and the end of last century, saying in almost identical words, that to imagine that the State can permanently improve the condition of the depressed classes is the dream of an enthusiast. A reduction in expenditure, and a respite from the perpetual increase of administrative charges for the furtherance of progress in Western civilization, whether needed or not, whether acceptable or not, whether suitable or not, would hardly affect the lowest classes to any very great extent, for they do not as a fact groan under a cruel salt tax and an excessive land rent.

No account of Hindu domestic life would be acceptable in this hall which did not touch upon some of the current problems of social reform, or, rather, upon the aspirations of the reform party. Novels appear from time to time written with the object of showing the need for protecting women behind the purdah, and suggestions are made that the Indian Government should create appointments for

legal ladies, who should tender advice to purdah women. It is, however, an altogether unfair assumption that purdahnishins are generally unfairly treated, and the intrusion of a stranger armed with official credentials, and very likely of a different race, religion, or caste, into the Hindu home would not conduce to its greater harmony and happiness.

Mr. Kipling says—"Even purdah women have always been in business touch with a thousand outside interests." Mr. Crooke in his work on the North-West Provinces, that part of India in which the need for legal advice is said to be particularly urgent, says—"Women exercise wide influence and control, whether within or without the zenana, and little that goes on outside escapes their ears." Mr. Crooke's book is one of the best ever written on India, and the *Pioneer*, knowing something of the United Provinces, observes that even if such appointments were created, "it by no means follows that they would be popular with the class in whose interest they are made." The purdahnishin lady can teach most people points in the law; she has already very substantial legal protection, and very much is presumed in her favour. Ninety per cent. of the purdah women in the North-West Provinces know that they are so safeguarded.

It is not clear then why the *Pioneer*, while remarking that such a change should not be made off-hand, though supported by a certain number of High Court judges, approves such a proposal, except that anyone who does not support every "emancipated" or "advanced" measure of reform is relegated to the black list of the reactionaries. The Hindus, their pockets, and their wishes, fall into the background when proposals (for which they alone pay) are put forward with influential support. It is also noteworthy that the actual proposal made is to provide for just such ladies as enjoy the protection and guardianship of the Court of Wards, viz., the Collector of the district, and are the least helpless of a by no means helpless class. Is it again true that, "among Hindu women, all, but the lowest class of servants," are secluded in North and North-West India, a statement made, and widely repeated in the English press? Mr. R. C. Dutt, in the "Lake of Palms," says the custom prevails "chiefly in the towns of Northern India, where the rule of the Moslems lasted for centuries." Mr. S. E. J. Clarke said the same of Bengal, and apparently of all India, viz., that women of the labouring and agricultural classes move freely about, and living away from towns are not under the custom of the purdah. "Girls," says Mr. Clarke, "are by precept, instruction, example and discipline, taught a high ideal of womanhood. Even purdah women go on pilgrimages, entertain and visit their friends, and see a great deal of the outer world, of which they want no more than they have. I deny that Hindu women have necessarily a miserable life, and must bear testimony to the happy side." Abbé Dubois's evidence is this,—"Quiet and retired as is the life of Hindu women, it cannot be said to be one of complete or rigorous exclusion."

Mr. Crooke, writing of the North-West (now United) Provinces, says:—"The prevailing note of village life is the absence of domestic privacy, and the publicity amidst which the people live. There is an utter lack of seclusion, except for women of the higher classes, and even among them the isolation is much less stringent than is supposed. Even behind the gloomy enclosure of the zenana wife and mother crave for gossip, and little that goes on outside escapes their ears. In the general management of the household they exercise wide control and influence. This is still more marked in the family of the peasant."

I quote at this length from Mr. Crooke for the North-West Provinces, and Miss Bhor for Bombay, because Miss Sorabji in a recent letter to *The Times* dwelt upon the prevalence of the purdah in these provinces.

The *Madras Mail*, one of the first English papers in the country, speaks well of the proposal, but points out that the aid wanted by purdahnishins is non-official aid, and that the practical difficulties may be insuperable. But the *Hindu*, one of the first Indian papers in India, scoffs at the idea that lady lawyers will be better than the existing male advisers as to ability and honesty, and asks why ladies, who are strangers to the manners, languages, and customs of the folks they are to help, should be able to help them. The *Hindu* says the whole scheme is impracticable, and that, as a fact, purdah ladies know the law very well, can manage their own affairs, and would object to "an expensive encumbrance to an already expensive administration."

The analogy of Lady Dufferin's Fund, which has been cited, is wholly untenable. That is a voluntary association to afford medical aid to women who otherwise would get none. The purdahnishin scheme is to assist female proprietors with official legal advice, which they can get, when they are disqualified from the

management of their estates, at the competent hands of a Court of Wards provided by Government, and fully equipped with legal advice.

The Dufferin Fund has done immense good, and no one knows that better than one who was for many years a Presidency Branch Secretary. But its successes have not been among purdahnishins. I pointed out in its early days, in one of the English reviews, that this must be so, and the *Amrita Bazaar Patrika* recently described the Fund as "based upon the fiction that purdahnishin ladies are not allowed in Bengal by their husbands to be treated by male doctors. Purdahnishin ladies are not in need of any special assistance, nor poor men in towns, but let the poor in the interior, male and female, have medical relief. There is no objection whatever on the part of Hindu or Mussulman ladies to be treated by male doctors. Hence Gosha hospitals built in towns remain unoccupied." They do for the most part, and the good work is done elsewhere, but the circumstances illustrate the ignorance and exaggeration of which the purdah system is fated to be subject.

The *Hindu Patriot* also recently pointed out that while the Fund had amply justified its existence, now that more than one and a-half millions of women are treated by women owing to its efforts, it has and must fail in its efforts to induce purdahnishins unnecessarily to go to hospitals.

There is no end to the error which prevails and is fostered as to the extent and the evils of the purdah system. A recent writer, whose "Kamala's Letters" has attracted a great deal of attention, makes one of his female characters say,—"The purdah does not exist in Hindu society except where wealth holds despotic sway. Where elsewhere it is found it is due to the new products of English education, who, rising in rank and position, under false notions, have taken to it." I would not accuse English education in this respect, but it is well to see the view held by the other side, just as profit may be extracted by reading in the *Bengalee* that "Englishmen are passionately fond of horses, which they value as highly at times, or more highly, than women. Who ever heard of 37,000 guineas for a racehorse, the price paid for Flying Fox." What will the Hindus think of a question in the House of Commons suggesting the provision of legal advice, at the public cost, for purdahnishins, "the first object," as Mr. Crooke points out, "of a man who has obtained a fairly respectable social standing being to seclude his women?"

The extent to which missionary teaching has directly affected Hindu domestic life is not so great as is sometimes represented. Even Keshub Chunder Sen, who, among many other extreme and exaggerated faiths, held "that Christ, with an army of missionaries, and not the Government with an army of soldiers, ruled British India," protested "against the denationalisation so general among native converts, who abandon the manners and customs of their country, and so are estranged from their countrymen, forgetting that Christ was an Asiatic." Little, however, can be based upon the rhapsodies of a prophet who, at one time inveighed against "the spiritual and moral destitution of India, the reign of idolatry and the tyranny of caste," and at another dwelt upon "the extreme spirituality of the Indian nature, and the unfortunate results of breaking down by extraneous influences the caste system which is the frame work of Indian society." Miss Noble, who has become a Hindu, is as good an authority on Hindu social life as Indian ladies who have become Christians, and she says—"From my own experience I can refute the charge of oppression of Indian women often levelled against Hindus. The crime of ill-treating women is at once less common and less brutal in form in India than in younger countries. Indian national customs require no apology."

It is a remarkable fact that while twenty-five years ago all the English-educated were reformers, by profession at any rate, a strong Hindu revival has characterised the last fifteen years, and at present an almost reactionary movement prevails, whether due or not to the teachings of the Brahmos and Theosophists of Mrs. Besant, Miss Noble, and Swami Vivekananda, to the effect that ancient Hindu ideals are all that can be desired. At any rate, when Miss Noble, or Sister Nivedita, says,—"Where woman unselfishly serves her dear ones from morn to dewy eve, domestic happiness is most often found," there will be few to gainsay her; and those who are most familiar with Hindu customs and languages, a necessary equipment for a knowledge of their domestic life, will recognise as true to the letter her description of Indian women, whose traditional virtues it is ridiculous to ascribe, as Baboo Mozoomdar did in London, to a conscience awakened by religious instinct due to a foreign rule, or to the influence, however good it may be and is, of a Christianity, which

that foreign rule is pledged not to force upon its Indian subjects. The Bishop of Madras lately characterised as too sweeping the statement of the late Bishop of Calcutta to the effect that no Hindu or Mohammedan student goes through a university course without having his religious relief destroyed or seriously impaired, and he said, as the Viceroy has, that there is a great danger in the present divorce between education and religion in India, adding that this is inevitable so long as religion in India takes its stand on tradition, and refuses to submit to the demands of criticism—a position I understand to be characteristic of true and orthodox churches elsewhere. At any rate we can say, as the *Novoe Vremya* said the other day of the Russians in China: "We are strong in these regions in proportion as we do not interfere with the religious convictions of the native population."

Religion is caste and caste is religion, and the *Hindu* newspaper, and the great reformer, Dr. Bhandarkar, seem to agree in thinking that the caste spirit increases with the spread of English education. The doctor says:—"In my early days all classes joined in a public movement, now Hindus, Mohammedans, and Parsees act independently, and even separate castes. There is greater estrangement than existed before social reform was thought of." The revolt against the Gains of Learning Bill, which the small class of highly-educated lawyers sought to rush through the Madras Legislative Council, is a significant proof of the truth of this opinion. The measure would have proved a powerful solvent of the caste system, and the Hindu home, with its joint family earnings. The Maharaja of Jeypore's recent justification of his caste-preserving attitude in England, and his public profession of partiality for "the old customs and traditions on which the foundations of the Hindu religion are based," is another straw showing which way the wind blows.

This purdahnishin protection movement focusses the very feelings against which a strong reaction exists.

Of course, the idea that purdah ladies will not see male advisers, influences those who support the proposal, and, of course, the idea is based on error.

Foreign observers see something of the facts. Prince Okhtomsky, who found fault with most of our proceedings, has a good word "for the kindly tolerant and amiable Hindu, and their loving wives and mothers." The author of "Kamala's Letters to her Husband," says by one of his characters—"Though it is the policy of our rulers not to interfere in our social and religious matters, it seems to me they do so when they choose. Much in our systems which may appear intolerable and unreasonable to a few, cannot be altered without interfering with the very character of our social fabric. There is no commoner fad of our hybrid products of English education than their twaddle about the cruelty of caste."

As a fact, at present, the more disagreeable incidents of the ceremony of re-admission of those who have lost caste in England, are being abandoned, and a Brahmin of high position recently had his offence condoned at the cost of a dinner party to brother Brahmins, and a bath in the sacred sea. The caste heads are as long-suffering and as pliant as our bishops and archbishops, but they cannot be driven, and indiscriminate abuse of their customs and religion only stiffens their backs, and encourages a reaction.

The president of an important (Coconada) social conference said the other day "that the families who put the reform paper programme into practice were kept at arm's length even by the reform associations, that there has been no progress in 25 years, that among the members of reform associations will not be found men of light and leading, that the reformers have been playing with reform, that many are losing their faith in reform, and are inclined to retrace their steps." The fact is none of them were willing to admit that caste would allow them to talk, but not to act.

The Abbé Dubois "believed caste to be the happiest effort of Hindu legislation, solely owing to which India did not lapse into a state of barbarism, and owing to which she preserved and perfected arts and sciences while other nations remained in a state of barbarism." This eminent missionary, in 1816, and Sir John Strachey, in 1899, alike urged that between caste, customs, and religion, no line can be drawn, and the former, with the wisdom of the serpent, pointed out that caste, which confines its professors to sectarian, local, and restricted interests, makes national life and national action impossible. He also allows the Hindus to be kind over indulgent parents and their women chaste, exacting and obtaining the fullest respect. Indeed, as regards their property and the custody of their children, I am not sure that Hindu women have not greater rights at law than our women at the present day. Sanscrit moral stanzas are full of saws on woman's side, while those in

which women are decried are no more numerous and not so severe as what we read in Greek, Latin, and British literature. They say: "Three persons are always well received, a brave soldier, a learned scholar, and a pretty woman."

Even Sir Monier Williams, a scholar of books, who looked on modern Indian practice as a disgrace to ancient Indian ideals, said—"It is most surprising that unhappy marriages are rare in India." He had the fact there, and his want of experience of the people supplied the surprise. He also got at the truth when he mentioned that "Hindu husbands do not beat their wives, and that women's influence over men is as great as their influence in Europe."

I have seen it suggested in graphic and interesting tales purporting to be a picture of Indian life that for Brahmin widows to remarry is no extraordinary occurrence.

That earnest, but temporate reformer, Mr. Dutt, one of the most English of Bengalis, though in the "Lake of Palms," he describes by the mouth of one of his characters the marriage of a Hindu widow from the Hindu standpoint "as a sin, public scandal, a madness beyond thought, an act against which the Hindu world would turn, as an outrage worse than a crime," yet represents a pious family as sanctioning such a marriage by the advice of a holy man, who pointed out that the "scriptures," if the Vedas correspond with the scriptures, "sanction remarriage." How far reforming zeal impairs the power of perspective will be obvious, when we learn in one page that "social boycotting has lost its horrors in India," and in another that "women of good birth and family dared not ask the married widow to their feasts and ceremonies."

The characters portrayed in this valuable and interesting book could never look without disgust upon such advertisements as occasionally appear in the Indian press: "Wanted, a young virgin widow, to be married to a bachelor of 24, with high prospects; fair, and good looking; object being reformation; full particulars and personal interview after approval of photo; proper party only need apply." This hardly satisfies Hindu standards of modesty, though hard by in Burma "Ma Thet hereby informs the public that Maung Po Min' is no longer my husband, has no claim to my property, and I will not be responsible for debts contracted by the said Maung Po Min'."

As to the misery of Indian widows, the reforming Indian press has fastened upon Sister Nivedita's (Miss Noble) statement that "the Protestant missionaries have misunderstood the matter, and that the widow is not regarded with aversion and contempt; that her position is the result of intensity of moral development, and not of its lack." This is, I think, a strong presentment of the case, but violent and unreasonable condemnation is the rule.

Sir Richard Temple wrote of Upper India—"Enforced widowhood is not nearly so general as is made out by those who would deduce a moral from Indian manners for the glorification of the habit of the Christians."

Take the figures for Hindustan proper, the North-West or United Provinces. Of the Hindu population 24 per cent. prohibit, and 76 per cent. permit and encourage remarriage of widows, and in all but the very highest castes every young widow finds a mate. Nearly a century ago, the Abbé Dubois, in ante-reform days, said: "Young widows bear their fate much better than might be expected. They are, perforce, resigned, and however despised a widow may be, one who remarries is a hundred times more so; shunned by every honest and respectable person, there are few widows who would not look on a proposal of remarriage as a downright insult. Nor is the resulting immorality as great as might be expected, owing to the chaste and circumspect demeanour of Hindu women." Mr. Beauchamp, the learned editor of Dubois, on this remarks, in 1897, "Those few who brave caste and remarry are invariably outcasted." Sir Madhava Rao pointed out how much less important this question is than is often represented, and showed that a very small proportion of prohibited widows, who are themselves a very small proportion, would, if permitted, remarry.

There are, however, steps the people can take to improve their marriage customs, and girls under ten are already less frequently married; but the late Sir Madhava Rao, an advanced thinker and one of the reform party, thought there was as much to deprecate as to imitate in our own system. He considered the life of a Hindu girl as happy as that of a bird or a bee, and by no means wanting in the knowledge needed for her life, and he thought as well of Hindu women, as others do who know them.

I cannot do better than end by quoting again my old friend, who was one of the most distinguished Hindus of his generation,

and a minister in two great native States. He said:—"Many writers on Hindu social reform have not clearly understood the existing system, which is the product of long development, nor accurately compared it with other systems, before underrating the advantages and exaggerating the disadvantages of the Indian system. The great majority of the people who retain their religious beliefs and social usages, would prefer non-representation to misrepresentation, by those who have given up those beliefs and usages."

DISCUSSION.

The CHAIRMAN, in opening the discussion, said it was only possible for him to mention the general effect on his mind of the study of India from the purely official point of view, and in that respect the domestic life of the people to a certain extent came before one's eyes in official papers. The subject dealt with by the author was extremely intricate and delicate. When he was in Bombay he thought he was justified in saying that perhaps there had not been before at that time a collection of three men of greater mental capacity, greater distinction in their own lines, and certainly not more prominent in such reform as they considered possible in India, than Mr. Justice Telang, Mr. Justice Ranade, and Professor Bhandarkar. Mr. Justice Telang had been a leader of reform in Hindoo circles, but towards the end of his days he allowed child marriage in his own family, and the gravest disapprobation was expressed towards him in the Bombay University Convocation. Mr. Justice Ranade likewise had to pay penance. Professor Bhandarkar, who was one of the most courageous Hindoos he had ever met, was the only one of the three who could stand up against something which had a tremendous influence on those great minds. It had always seemed to him that the two gentlemen he had mentioned had been influenced by domestic influences; it was the home life which caused them to recede from the very strong line they had taken up as regards reform. He could not believe that a woman's influence was very different in other races to what it was in the English race, and knowing the influence a woman had in domestic life, one could understand its enormous power in the life of a reflective and religious people like the Hindoos. Occasionally, both in India and in England, he had played cricket. At the Bombay Gymkhana there was a Hindoo professional bowler, who one day came to the secretary and told him that he was obliged to leave. The secretary expressed his regret, and asked the bowler if he could do anything to make him change his mind; was he receiving enough pay? The Hindoo replied that he was getting very good pay, but he was going because his caste would not allow him to play with Englishmen who ate beef—and he went. Although that might, to some people, appear ridiculous and tyrannical, he did not view it in the same light. It was a very good thing in the life of a people that there should be something strong, resolute, and binding, which attracted their attention to a subject akin to religion, and he did not think there was very much distinction to be drawn between caste and religion. From his cursory experience of domestic life in India, it seemed to him that the people of the country possessed four very admirable characteristics. In the first place, they were a very cleanly people. He was not at all sure that a great deal of the cleanliness of English people did not come from India. The daily bath, he believed, was hardly known in England until the Anglo-Indian came back in larger numbers than before. In the second place, he presumed it was simply common-place for him to say that the natives of India were a highly religious people. He thought the difficulties they overcame, and the inconveniences they subjected themselves to in visiting sacred shrines was very admirable, and, as he had already said, it seemed to him that caste and religion were very much akin. In the third place, although, of course, there were easily observable exceptions, the natives were a most sober people, although there was plenty of opportunity for drinking those fermented liquors, which could so easily be obtained in some parts of the Bombay Presidency. The author had mentioned that it was easy to make ridicule out of a number of things the Hindu would worship, for instance, the tools he used. There was a very great difference between religion and devotion. Many Europeans were devoted to the particular tool they used, and had a superstition that, unless they used that particular tool, they would not be successful; and surely, if McAndrew's hymn meant anything, it meant that McAndrew was a worshipper of his engine. Lastly, were not the natives a most charitable people? It had struck him most forcibly while he was in India, that there was no Poor-law; it had not been necessary to make a law to provide for the poor, because, he presumed, it was customary among the natives to be charitable. It was no doubt a fact that caste had become exaggerated. Every system, if closely observed by those who were under the domination of the class responsible for the closer observance of the customs of the system, was liable to become exaggerated. That was seen in all the systems of the world. But it had always seemed to him that, although there was that liability to exaggeration, there was, on the other hand, a remarkable power in India of adapting what was useful to India. As each invasion had swept over the country she had bowed her head to the invasion, and patiently and by degrees had absorbed all that was adaptable to the climate, country, customs, aud people. Presently the wave of invasion had gone back, and the stalks had sprung up again all the better for what had gone over them. During the five very busy years he spent in India he came to

the conclusion, from what he could learn from the papers, and from what Lady Harris told him she saw herself, that the domestic life in India was in not one particular less happy than the domestic life in England, that in many respects it was equally admirable, and that in many ways it was as strong a factor in producing those characteristics and tributes which went to make the whole social life of a people bearable.

Sir WILLIAM LEE-WARNER, K.C.S.I., observed that Mr. Rees had travelled rather far a-field in his paper, from the hearth to the State, and over administration and legislation, thus offering points for disagreement as well as agreement. The speaker concurred with him that reform must be by evolution, and proceed from within. He also concurred heartily in the amiable qualities of the Hindu, and would have dwelt more upon their patience, not the submissive quality of the animal creation, but their manly patience under the divine hand and nature's angry visitations. More might have been said of their ready gratitude for any kindness. What Mr. Rees had said about India being many nations was true. Madras Hindu society, as described, was not the Hindu society of the north, nor of Bombay, nor even of Mysore. Madras suffered from want of competition and contact with the outside world. That was why the Mohammedan rule so little affected its Hindu ideas and practices. The rest of India was forced to compromise and change its institutions from time to time by the pressure of contact with other people and other ideas, which was less felt in the peaceful isolated south. However, even when all allowances were made for this, the speaker felt bound to express his dissent from the tone of helplessness which pervaded the paper. Mr. Rees dwelt, with evident satisfaction, on the alleged inability of British law to alter or affect caste. He threatened administrators with all sorts of pains and penalties if their actions affected caste, and he denounced Hindu and European writers for writing novels and books that offended caste. This was going too far! The law was not powerless. The Penal and Procedure Codes were felt in every household in India, and as every caste man was also a citizen of the Empire, his conduct in caste matters was more or less modified by his legal duties as a citizen. Even special laws regarding suttee, marriage, religious converts and toleration, abolition of slavery, had effected the object designed without any cause for complaint. As to the conduct of public servants there was nothing in the noble proclamation of Queen Victoria which could be twisted into an obligation to put caste regulations before public law or legal rights. Then, as to the denunciation of writers and reformers, Mr. Rees should study the Telang school, and Mr. Ranade's essays, published by Mr. Kolaskar. Mr. Rees had said warmly: "We know nothing about Veda times," but he could not deal with Hindu life or caste without a survey of the history of the Hindu religions. Mr. Ranade preached that reform was only the "work of liberation," of retracing steps to the glorious liberty of the past, and of adding what was best adapted to Hindu life in the conditions in which we live. The best prophet of the future was the past. Hindu caste had changed in the past, and if it was to live in times to come with their altered circumstances, it must change wisely and slowly. Its own leaders must show the castes the road to change, and we ought to say and do nothing to make their task of judicious reform more difficult than it was. The revival, of which so much had been said, showed that the leaven was at work.

Mr. A. SARATH KUMAR GHOSH said the standpoint he had adopted in viewing the question was that merely of the fiction writer, which would not be acceptable to those people who had studied the matter from the standpoint of the careful and critical observer. After expressing his thanks to the author for the catholic manner in which he had stated the subject, he said he thought the author might have dilated upon the doctrine of re-incarnation, because it seemed to him that the whole basis of Hindu life was wrapped up in the belief in re-incarnation. People did not talk about it, because it was such a mystic subject that they confessed no human being could know much about it except to accept it as a matter of faith. Looking at the pathetic side of Indian life, whenever there was a great tragedy the resignation and the patience with which it was borne, as mentioned by the author, could be traced to the belief in re-incarnation, the belief, either conscious or unconscious, that in a future state all would be improved, not necessarily by the degree of fate but by one's own acts. If they recognised that fact they would be able to understand some of the inner workings of the Hindu mind, and find a motive for conduct, when otherwise it was considered to be the mysterious side of Indian life. People sometimes said in the papers and in novels that it was never known how a Hindu would act under given circumstances; but if they took into account the main springs of human action a solution would be obtained, as in the doctrine of reincarnation. He did not agree with the author in thinking that marriages were made in India entirely by the parents, and that the young people had no option whatever. That was true universally, but in the villages the young people often had an option. Whenever there were three or four suitors proposed, the prospective bride might be more favourably disposed to one of them; she might then be able to influence her mother, who, in turn, would be able to influence the father.

Mr. N. B. WAGLÉ said that it gave him the greatest pleasure to congratulate Mr. Rees on his admirable paper, which showed the author's close acquaintance with the Hindoo shastras as well as the customs of the present day. But Mr. Rees, in the

course of his remarks, stated that he did not see any use in introducing the study of Hindoo philosophical works into Indian colleges. Having received his training at one of these colleges, he (the speaker) could say from experience that the little insight a student can get while at college in Hindoo philosophy is highly beneficial to him. The aim of the paper, so far as he could see, was to point out that Hindoo society was a good society, and that it required no change or interference of any sort. While Mr. Rees tried to maintain this, he hinted an attack on the cause of reform. He had no objection to accept every word the author had said, as to the ancient Hindu home being a good home, the influence a good influence, and the society as a good as any other civilised society; but it must be remembered that the times had changed; they had come in touch with Western institutions and thought, which is entirely of a different character, and the conflict was so great that either they must discover a compromise for the very existence of that society or be prepared to take the risk of a catastrophe. There could be no doubt that the Indians and the British had to live together, and it should be their endeavour to strengthen the political ties which existed between them as the subjects of the same Empire by social, intellectual and moral ties. If such fusion of communities was to be brought about it must be done in every side of Indian society, including even the domestic. Some people had refused to be influenced by Western thought, which was gradually moulding the Indian mind; they stood where they were and refused to move with the times. There might be others who considered that the old institutions were wholly injurious. Amidst those two classes the problem for the reformer was not as Sir William Lee-Warner had put forward, to reject superstitions and introduce everything that was based on the right notions of old Hindoo society, but to bring about a compromise between the two civilisations, to adopt what was best in the Western influence and retain only what was best and what could practically and profitably be retained from the ancient Indian institutions. The Chairman had mentioned that the late Mr. Justice Telang and the late Mr. Justice Ranade had committed acts which it was thought that the leaders of reform ought not to have done; but these two great men were crushed between the weight of these two conflicting civilisations; that was the great dilemma in which the reformers were often placed. Mr. Ranade and Mr. Telang had both gone, and their place had been taken by Mr. Justice Chandavarkar, who, a few months ago, showed his fearless and decisive attitude towards the social reform movement in India in his most able address in that hall. Under his guidance, they could be pretty certain that reform would be worked out effectively and in the right direction, and the Hindoo society would surely deserve all the commendation contained in the most learned paper they had had the pleasure of hearing hat evening.

Miss CORNELIA SORABJI said that when she listened to the author's extraordinarily clever and able paper and his interjected remarks, she was reminded of the old story of the advice of a husband to his wife about writing letters: "Whenever you write a letter, if you want to attract attention, begin with a retort." The paper, with the exception of the descriptive parts, which were charming, gave one the impression of one long retort. Why, she did not know. She could not tell who the individuals were to whom the author took exception, who had given English people such an extraordinarily wrong impression about India; in fact, if one carried one's mind back for the last 15 years, it would be remembered that everybody had been trying to think the best of India, had been trying to put forward old influences in their delightfully attractive light, old experiences in their beautiful picturesqueness, old ceremonies with their beautiful meanings. The restrictions of family life had been glorified; indeed in that room only last year she heard a charming address from a lady on Hindu life, partly on the Vedic times, and partly on the present age, which was not only full of admiration, but almost of adulation. Further, if one objected to the ways of the reformers, was it not better to let their suggested reform die? Why waste energy in opposition? Friction, it seemed to her, never helped anything in any department of life. If the thing was not worth doing it would not get done. There were excellent people at the helm. With Lord Curzon for Viceroy, with the different Governors, who gave all their time and attention, with their special Legislative Councils, to any question of reform which touched the country, it was hardly necessary for people who, though at one time they were experts, afterwards necessarily were *ex officio* laymen in this country, to thrust at anything that might be projected for India. Reformers, at best, had a hard time not only with their own people but also with the ontsider who did not know and did not understand; and she thought it might be more helpful in the long run to leave them alone. The author had done her the honour of mentioning a scheme which she had the privilege of putting before the Government, and which *The Times* of last September most kindly supported. The present was not the place in which to discuss it in detail, but she desired to correct one or two mistakes. The scheme was not a scheme which touched any national custom with a view to uprooting it ruthlessly; in fact, it was a conforming to a great national custom. The author had said that the custom of the purdah did not exist in India. She had for the last eight years travelled up and down the country collecting facts and statistics on the point. The women who were described as going to the well to draw water were not purdahnishins. The purdah system was confined largely to that part of the country under Mohammedan influence, and how great the Mohammedan influence was in North India, North-Western India, and in the Moslem States of Southern India, any historian

knew. Nowadays anybody who acquired a better position in life shut his women away in the purdah, as an Englishman might acquire a country house or a motor-car; it was respectable, and the women liked it. She did not say it was a bad custom on the whole, but it sometimes did work injustice to the purdahnishins themselves. When they could not get at lawyers to help them, as when they were owners of property, reflection alone would suggest some of its inconveniences. If one had to talk to a person through a closed door and make a will with the beneficiary present, it might lead to a little rupture and unpleasantness. Not only was reform wanted in the interest of the purdahnishin, but in the interest of the outside world. Anybody who had studied the law reports would know how often a contract was avoided in the name of the purdahnishin. The law, as now administered, protected the purdahnishin. In the old days there was no protection for her. Why? Because she did not exist. She was invented after the Moslem invasion of India, and, therefore, it had been necessary since the occupation of the British to protect her. They had done all they could but there was just that shut door. Why was it that so few purdahnishin cases came into Court, although it was time, and again proved incidentally that they had been wronged? It was, as Judges of the High Court would say, because of the insuperable barrier between them and justice. When they did come into Court, it was often because somebody was taking advantage of the purdahnishin to avoid a contract. It was in the interest of the outside world as well as of the purdanishin that reform was wanted. In regard to the need for the work, the letter which *The Times* published quoted the opinions, backed by cases, not only of eminent ex-administrators of those parts of India, where the purdahnishin system prevailed, but of Jugdes of the High Court now in India, so she thought it was hardly necessary to quote people who had not written on the subject.

Mr. Rees, in reply to Sir William Lee-Warner, said the village he selected was half-way between Madras and Calcutta. He gave his reasons for selecting a Madras village; but like Sir William Lee-Warner he knew other parts of India besides Madras. He had quoted authorities as regards the North-Western Provinces, Bengal, and Bombay, and the authority he had oftenest quoted, Abbé Dubois, one of the best that ever wrote upon India, was an authority who wrote upon Mysore, about which Sir William Lee-Warner had spoken, and in which both he and Sir William had served, and from which the Chairman took his title. He had supplemented his own knowledge of other parts of India by the authorities of other people who might be considered to know individual parts much better. As the point had been raised, he would state that he himself was a Government translator for a great many years in Persian and Hindustani, had travelled and served in many places outside Madras, and could not allow in any way that his paper was a Madras paper. Sir William Lee-Warner had said that he (the author) had despaired of Government doing anything for the distressed classes. He had quoted two great authorities who despaired, but he himself on other occasions when the matter was a direct issue had indicated directions in which he thought Government might do something to raise the conditions of such classes. In regard to the Acts of the Indian Legislature, he had referred to the Age of Consent Act, but was thinking more of the abortive Gains of Learning Act, and the Malabar Marriage Act. When Sir William spoke of the Penal Code, he could not help thinking of a definition of that code given by a famous writer on India, namely, that it was regarded as a useful summary of things which it would be better to avoid doing. From that point of view as well as from others he agreed with Sir William Lee-Warner in thinking that it was a great educational code, and had not a word to say against it. He did not object to what was said in Mr. Dutt's novels, or in those of other writers, who had been successful in describing Indian life and who had done so great a service by bringing it before the public in England. He admired these writings as much as anybody did, and did not object to what they wrote. He had quoted from these novels, what characters in them had said, as bearing out the views he put forward in regard to caste. It was one of the difficulties inherent in dealing with such a subject that the author was supposed to agree to the letter with everything he quoted. He did not mean to do so. Sir William, in speaking of the Vedic times, said that if something was not known about such times we ought to learn about them. He had read up books about the Vedic times in the Indian and English languages; but if one attempted to go back to the Vedic times, as far as the Hindu was concerned, it would be precisely the same, as if the people in England to-day were to attempt to go back to the scheme of life and conversation put forward in the Sermon on the Mount. In neither case could existing society adopt the earlier, simpler and nobler scheme, although no doubt, at the time it was put forward, it was the best possible life for the world. After thanking Mr. Waglé for his extremely kind remarks, with most of which he agreed, Mr. Rees continued that he had hesitated to go into the question of Hindu philosophy, mentioned by Mr. Ghosh, for reasons which would be understood. His subject was already fathomless. When he remembered the reformer mentioned by the Chairman who married his daughter as an infant, he could not help thinking of the great reformer and founder of a new religion in India—the cardinal point of which was the rejection of caste,—who did the same. Most of the reformers in their private life followed caste scrupulously. He took it as a great compliment that a lady of such enterprise and great talents, with such extraordinary facility in public speaking

and in writing, as Miss Sorabji, had been kind enough to speak. She had stated that people had recently put forward the picturesque side of Hindu life, and that everything had been done to palliate and excuse the existing state of things. But he maintained that the state of things in India did not call for excuse or palliation, that a good and suitable state of things existed, and there was no greater need for excuses in India than elsewhere. She had also stated that if reforms which had been put forward, such as her purdahnishin scheme, were not intrinsically good they would die. It was true that they might, but it was equally true that they might be adopted. In that case he thought criticism was a good thing, and was sure that a lady of Miss Sorabji's enterprise and intellect must know that it was better that the opposite side should be put forward, even by a person so unequal to the task as himself, rather than it should be left unstated. She had also stated that the Legislative Councils would do everything that was right. Having been a member of the Legislative Council, he knew that they were composed of human beings, and that they would not resent, and sometimes needed, a little outside assistance. When Miss Sorabji spoke of the hardships of the reformers, there was nobody in the room who sympathised with her more sincerely than he did himself. He sympathised with people who had the courage of their convictions (of whom Miss Sorabji was a shining example), and who stood up against all the difficulties with which they had to contend, but it did not follow that they were on that account the more competent to reform the customs and religions they had left. He also wished to point out to Miss Sorabji that he had quoted other authors in support of his positions. He quoted Mr. Crooke, for the North-West Provinces; Mr Clarke, for Bengal; and also Captain Temple, now Sir Richard Temple, for Upper India. In reply to Miss Sorabji's statement that few purdah cases were brought into Court, he believed that the fewer cases were brought into Court the better it would be for India, whether the cases were those of the comparatively few purdahnishins, or of the multitudinous folk who were no more purdah people than ourselves.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Rees.

MR. T. DURANT BEIGHTON writes:—As one of those who were precluded by lapse of time from taking part in the discussion of Mr. Rees's interesting and suggestive paper, perhaps you will kindly allow me very briefly to indicate what I intended to have said had time permitted. I will endeavour to imitate the modesty of the civilian of whom Lord Harris spoke, and confine my remarks to that portion of India with which I am best acquainted, viz., the Lower Provinces of Bengal. I was surprised during the course of Mr. Rees's paper, and still more so in the debate which followed, to find that the quality which is, in my opinion, alike the crowning virtue and the most noticeable feature of Hindu domestic life was absolutely ignored. Lord Harris spoke of the Hindu characteristics of temperance, patience, and courtesy, but all the speakers omitted to lay stress on their humanity, as shown by the uniform kindness to children which beautifies the family life of the Hindu. I have no sympathy with those who constantly disparage their own countrymen, but the frequency of illtreatment, neglect and cruelty towards children by parents in this country is undoubtedly a blot on the national escutcheon and a disgrace to our civilisation and Christianity. But there is no room for the operations of the National Society for the Prevention of Cruelty to Children in Bengal, for the crime doest not exist; its officers would be idle and their work a sinecure. During my 26 years of service as Magistrate, Judge, and Member of Council not a single instance has come before me either in my public or private capacity of the illtreatment and neglect of children which form so pathetic a part in the pictures of domestic life in this country presented by the daily press. Nor is the systematic illtreatment of women common in Bengali households. Murders and violent assaults no doubt occur, and are due in most cases to that *teterrima causa*, jealousy, but criminologists will agree that this distorted and morbid product of a natural and even laudable sentiment is a less heinous motive for crime than others where cupidity is concerned, and one which is hardly a stigma on the national character. As a study in sociology, it would be interesting to trace the sources and development of these kindly parental and conjugal relations. Exigencies of space compel me to restrict myself to the suggestion that the origin is to be found in the dogmatic theology of Manu, to whom Mr. Rees has made such frequent reference. To those who doubt the value of the ethics of Manu in moulding the character of Hindus in the direction of humanity I would venture to commend the eloquent words of Sir W. Jones in his preface to the Institutes, in which he speaks of "the spirit of sublime devotion, of benevolence to mankind, and of amiable tenderness to all sentient creatures" which pervade the work. But the priceless spiritual benefits conferred on a pious Hindu by a son or a daughter's son must inevitably enhance the value of offspring and add a powerful stimulus to the ties of natural affection. [cf. Manu ix. §§ 137, 138, and 139.]

Into the controversy between Mr. Rees and Sir W. Lee-Warner I have no space to enter, but I demur to Mr. Rees's proposition that "caste is Hinduism and Hinduism is caste." As well might a Roman Catholic say that the observance of mass and confession was Christianity. Conformity with the rules of caste may be evidence that the conformist is an orthodox or even a religious Hindu, just as the compliance with accepted rules may be one step towards showing that a man is a devout Roman

Catholic. But both the Hindu and the Roman would alike protest against this narrow creed being of the essence of their religion. Nor can I at all agree with what I understand to be Mr. Rees's view of the Queen's Proclamation of 1858, if I am right in supposing that he considers the abolition of *Sati* and other Acts passed prior and subsequent to that Proclamation which compel Hindus as well as all other subjects of the Empire to abandon practices which conflict with the general criminal law, as a violation of the guarantee to safeguard their customs and religion. Besides the abolition of Sati, the Legislature has within the last century put an end to human sacrifice, the exposure of children for destruction by sharks and alligators on the banks of rivers, the murder of so-called sorcerers and witches, the practice of *dharna*, the burying alive of lepers, and the mutilations which formerly attended the celebration of the *Charak Puja* or swing festival. I may, perhaps, be allowed to say that I have dealt at length with all these practices and their origin in an article published some years ago, called "Obsolete Crime in Bengal and its Modern Aspects." Will it be believed for a moment that not a vestige of what Mr. Walter Bagehot calls "verifiable progress" in morality has been established in India among the masses that have been subject to our rule for so many generations? Every one of the practices above mentioned can be justified by scores of texts from the *shastras*, but I doubt if anyone will seriously maintain that the authoritative prohibition of these crimes by the Government is regarded by the most fanatical of modern Hindus as prejudicially interfering with his customs or his caste, or that he would not scout the suggestion of returning to these and kindred outrages against civilised life, even if the prohibition were removed.

One word more. In the difference of opinion which manifested itself between Mr Rees and Miss Sorabji, whose high intelligence and charm of manner add to the value of any debate in which she takes part, I entirely agree with Mr. Rees. Notwithstanding the unusual honour of large type which was accorded to Miss Sorabji in the *Times*, I think the intrusion of an outsider into the domestic circle, especially if armed with the ægis of official sanction, would be useless for the purpose suggested, and would tend to subvert that mutual confidence and affection which is the greatest charm of Hindu life. Where *purdahnishin* women are capable of entering into legal business (and where they are not, *cadit quæstio*) their customs give them ample opportunity of discussing matters *vivâ voce* at any length with friends, lawyers, and officials, their faces remaining hidden behind the *purdah*. This fact must be known, by his own experience, to every prominent official in India.

Mr. VISHVANATH P. VAIDYA writes testifying to the correctness of Mr. Rees's description of a Hindu home. He adds :—Lord Harris cited two instances of prominent Hindu reformers bowing before the influence of caste. Could they have done otherwise with any advantage to the society to which they belonged, and which they were working hard to improve? The only answer is in the negative. They acted upon the well-known principle taught in England by Edmund Burke. If they wanted to lead they must follow the feelings of the people whom they wanted to lead. Acting otherwise would have meant self isolation and annihilation of all their influence over those who would be guided by them. It is a self-sacrifice leaders have often to make. Mr. Rees is right in what he says about the condition of women in India. A woman is the ruler in the family. In domestic matters a husband should be, and often is, a subordinate. A Hindu lady may not be learned in books, may not discuss politics, yet she is an intelligent assistant, with supreme power in the house. To put her in any other light is doing injustice to Hindu society. I do not agree with Mr. Rees's views as to the study of philosophy in the colleges. Need I remind him that many native administrators in India were very good students of Indian philosophy?

NINTH ORDINARY MEETING.

Wednesday, February 4, 1903; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., in the chair.

The following candidates were proposed for election as members of the Society :—

Beisenberg, H., Rathcote, Pattison-r ad, Hampstead, N.W.

Bell, James, 34, Kensington-square, W., and Guildhall, E.C.

Daw, John Williams, M.I.M.M , Ashanti Goldfields Corporation, Limited, 6, Southampton-street, Holborn, W.C.

Fraser, J. C., Messrs. Stephen, Fraser and Co., Limited, Port Elizabeth, South Africa.

Gould, Edward, care of Standard Bank, Barberton, East Transvaal, South Africa.

Mitchell, George, M.I.Mech.E., The Vacuum Brake Company, Limited, 32, Queen Victoria-street, E.C., and 59, Frances-road, Windsor.

Morgan, Edward Domett, A.I.E.E., 73, Wightman-road, Harringay, N.

Munro, John, O.K. Copper Mine, *viâ* Mungana, North Queensland, Australia.

Nanjiani, Khan Sahib K. R., Godhra, Panch Mahals, Bombay, India.

Quicke, William G., Assoc.M.Inst.C.E., Gas Works, Perth, Western Australia.

Tilden, Douglas, 1545, Webster-street, Oakland, California, U.S.A.

Townsend, E. Ross, Agricultural Offices, Salisbury, Rhodesia, South Africa.

The following candidates were balloted for and duly elected members of the Society: —

Atchison, Arthur F. T., Cooper's-hill, Englefield-green, Surrey.
Cater, Herbert Elliott, B.A., Southdown, The Downs, Wimbledon, S.W.
Day, Harry Daborn, Railway Approach, Godalming, Surrey.
Eliot, Sir Charles Norton Edgcumbe, K.C.M.G., C.B., Government-house, Mombasa, East Africa.
Fletcher, Banister Flight, 29, New-bridge-street, E.C.
Ford, Albert, Welsbach Light Company of Australasia, Limited, Wellington, New Zealand.
Isherwood, William Herbert, 18, Wrangthorn-terrace, Hyde-park, Leeds.
Russell, Charles Bartlett, 16, Teignmouth-road, Brondesbury, N.W.
Toogood, John F., F.R.G.S., Bipposu Mines, Ltd., Ashanti, West Africa.
Walsh, Albert, P.O. Box 39, Cape Town, South Africa.
Wilson, William, 1, Belmont-street, Chalk Farm, N.W.

The paper read was—

METHODS OF MOSAIC CONSTRUCTION.

By W. L. H. Hamilton.

It is now more than sixty years ago since the revival in this country of mosaic as an architectural adjunct may be said to have begun. In 1840, Mr. Blashfield endeavoured to produce decorative pavements, and in this endeavour he was assisted by Mr. Minton and Messrs. Maw and Co., who succeeded in making excellent material for that purpose. Following Mr. Blashfield (and to a certain extent working in co-operation with him) came Sir Digby Wyatt, who, in 1848, published a work on the subject, and gave much practical assistance to the manufacturers who were engaged in producing the tesseræ. Their efforts appear to have been mainly concentrated on the production of pavements, geometrical in design, and made of such materials as asphalte, coloured cement, and compressed china clay. The results obtained were so satisfactory that on the announcement of the intended exhibition of 1862, Messrs. Maw and Co. decided to move a step in advance of what had hitherto been done, and to produce a pictorial pavement in several colours. They therefore commissioned Sir Digby Wyatt to design a pavement of that character for them which they executed in tesseræ of nearly a hundred different tints made by themselves; and as Sir Digby Wyatt states "this was the first practical effort to revive pictorial mosaic amongst us."

Such was the position of the mosaic art in England in 1862. It shows that a certain interest in the art had been created, and this interest was stimulated by Sir Digby Wyatt, who in that year read a valuable and most interesting paper before the Royal Institute of British Architects on "Pictorial Mosaics as an Architectural Embellishment," dealing with the subject (as he himself states) from the point of view "from which we may best realise what architects have to learn and to do, in order to effect a practical revival of the art at the present day," and with this aim in view he gave the main historical phases of pictorial mosaic, and dwelt upon the various scopes and difficulties of the art in its production and application.

Many artists and architects now gave serious attention to the revival of the art. The improvement in public taste, aided by an increased feeling for colour and decoration, gave encouragement to those who were interested in the revival, and it was not long before several eminent firms in this country succeeded in producing mosaics in enamel. The names of Messrs. Simpson and Sons, Messrs. Rust and Co., and Messrs. Harland, Fisher and Co., occur to me, as some of their full length figures are to be seen in the principal hall of the South Kensington Museum. But not until some years later were any important enamel mosaics executed in this country.

In Italy, the traditions of the workers in mosaic had been handed down through centuries, and although the art had fallen low, it had never altogether died out. About the year 1860, a poor glassblower of Murano, named Lorenzo Radi, with the love of his art strong within him, made efforts to improve the manufacture of enamels, and especially of gold mosaic, and in his necessity he applied to a Venetian lawyer, Dr. Salviati, who found the means to enable him to continue his efforts in the production of the Smalti (or enamel), by means of which Radi was endeavouring to revive the mosaic art in Venice. In a small way these efforts were successful, but for want of means and prestige they would have resulted in failure, had not an artist of high merit and great social position extended to them a helping hand. I refer to the late Sir Austen Henry Layard—a man who was not only an artist in the highest and broadest sense of the term, but who was also a distinguished diplomatist

and archæologist. From the moment he extended his protection to the revived industry, the success of that industry was assured. He, together, with a few other English gentlemen, provided the necessary capital. The business which had been established by Radi and Salviati, became their property, and was speedily merged into the concern which they then formed under the title of the "Venice and Murano Glass and Mosaic Company."

The first important commissions obtained by the company were the decoration of the Wolsey Chapel at Windsor and that of the Albert Memorial in Kensington-gardens. The general designs for both works were by Sir Gilbert Scott, and were carried out under his directions from the cartoons of Mr. John Clayton, of Messrs. Clayton and Bell.

About this time also were executed for the South Kensington Museum several full length figures from the designs of the late Lord Leighton, Sir Edward Poynter, P.R.A., Mr. Val Prinsep, R.A., and other distinguished artists.

In Westminster Abbey, the "Last Supper," over the communion table, was executed from the design by Mr. Clayton; and in St. Paul's Cathedral two of the large spandrils under the great dome were covered with mosaics from cartoons by Mr. George Frederick Watts and the late Alfred Stevens.

From that time to the present day much excellent work has been done in various parts of the United Kingdom, in the Colonies, and in America, by several well-known English firms of mosaists as well as by the Venetians, and the demand for mosaic decoration is steadily increasing. Of that there is no doubt; and the question of the hour is not whether mosaics should be executed, but *how* they should be executed so as to obtain the best results at the least possible cost. It is with a view to elucidating this question that I have prepared some notes on the methods of mosaic construction which I hope may be of interest, and may at the same time tend to remove misconception and prejudice.

Speaking broadly, there are two methods of construction:—

(1) The Old Method, viz.:—That of fixing the tesseræ on the wall directly and one by one.

(2) The New Method, whereby the mosaic is first executed on paper, and thence transferred to the wall.

The *Old Method* is simple enough; the wall destined to receive the mosaic is prepared with cement, the cartoon is outlined on the cement, and the mosaists, with the cartoon before them, proceed to place the tesseræ on the wall one by one.

It is needless to say that under certain conditions the very finest mosaics can be—and even in recent times have been—produced by this method. The ancient mosaists it would seem invariably employed it, and probably no other process was known to them.

The first works executed in England by the Venetian mosaists were so executed, and the result was entirely successful, but it was soon made clear that unless some less expensive and more expeditious means could be devised for executing and fixing mosaics very little could be done to advance the art either in this country or elsewhere.

Anyone possessing a knowledge of mosaic art knows that it is futile to expect the production of a really good mosaic unless the work is carefully supervised by a properly qualified artist. Men no longer "work for the angels," and even the best workmen require the supervision of the master. Where the artist is designer and mosaist in one, as were so many of the ancient mosaists, and where time and money are secondary considerations, the principal disadvantages of this method disappear; but it is rarely indeed that such a fortuitous combination of circumstances is to be met with. The artist who by reason of his genius and reputation, would be commissioned to design a scheme of mosaic decoration for some large cathedral or public building, would probably not be a mosaist in the sense of possessing a close technical knowledge of the art, and if he were, he could not be expected to overlook for several hours each day the workmen who are placing the tesseræ on the wall. Even supposing it were possible to secure so considerable a part of his time, the cost would necessarily be enormous. His designs and intentions have therefore to be carried out by another, who must be both artist and mosaist. Such men are not easy to find, and when it is remembered that any large firm of mosaists working by this method would require to retain on their staff many such artists, it will be seen that the difficulty presented is a very formidable one indeed.

Another difficulty which presents itself in the application of this method is the necessity of sending workmen from their homes to any part of the world where a mosaic is to be executed. In the first place it is difficult to get first-class workmen to leave their homes,

and if this difficulty be overcome by increasing their remuneration, the necessary expenditure for travelling and maintenance adds largely to the cost of the mosaic.

Then again, where the mosaists have to work on the spot, only a very limited number can work on the cartoon at the same time, and on such days and at such times as the condition of weather and light will permit so that the work must necessarily proceed slowly.

These are difficulties which directly affect the *cost* of the mosaic. There are also difficulties which may, and in many cases do, affect the *quality* of the work. The conditions under which a mosaist working on the spot has to carry on his work, are frequently well nigh insupportable. He is dependent on the climate of the country in which he finds himself, and even under the most favourable atmospheric conditions he must work in the imperfect light which comes to him through the shrouds and scaffolding by which he is surrounded: in winter he is chilled by the cold, and in summer he is half suffocated by the heat: he has to lie in all sorts of uncomfortable positions—sometimes on his side, and sometimes on his back; and in spite of all these difficulties he is expected to exercise to their best his faculties and skill in reproducing not only the design, but the exact colours of the cartoon which he is engaged in copying. What wonder if, under these circumstances, when the scaffolding and shrouds have been removed, the mosaic is discovered to be faulty and that some parts have to be demolished and begun all over again, or, worse still, the defects are permitted to remain because the expense of removing them would be too great!

Fig. 1.

Mosaists Working in the Studio.

There are in addition technical difficulties into which I need not enter. Those I have cited are sufficient to indicate the reason which led the mosaists who 35 years ago revived the art, to the conclusion that unless some other process could be found, little progress could be made either in this country or abroad.

When one remembers how much that is

beautiful in mosaic art has been produced by means of this ancient method, it seems natural enough that it should have the affection, and even veneration, of many mosaists. To abandon it is to break with the past, and artistic sentiment is conservative, but

"the old order changeth, yielding place to new,"

and there are many indications leading to the conclusion that, except with reference to small works in which the designer is intereste d as mosaist, this venerable method will not survive the stress of modern conditions, and that the existing wave of opinion in its favour will, after a few costly experiments, subside.

In expressing this opinion, I do not forget the important work recently executed in the choir of St. Paul's Cathedral, but in that case the work was carried out under all the conditions necessary for the successful application of the method; there was no want of money, no limitation as to time, and the mosaists were under the direct control of Sir William Richmond, who designed the cartoons. It would be quite out of place here to criticise the result, but it would be interesting to know the cost, from first to last, of each square foot of mosaic executed, including the fees paid to the distinguished artist who superintended the work.

I now come to the *New Method*. The Venetian mosaists having decided to abandon the application of the old method to the construction of *decorative* mosaics, adopted, developed, and, after many costly experiments, brought to perfection the method which has become associated with their name and which they have applied to nearly all the large decorative works executed by them during the past 30 years. This method, or process, was explained by the late Sir Austen Henry Layard in the following passage of a paper read by him at a meeting of the Royal Institute of British Architects :—

"The necessity of working on the spot is now avoided by an ingenious process, which, however, is only applicable to decorative mosaic, and cannot be used when much delicacy of execution and extreme nicety in the gradation of tints are required. The workmen reverse the cartoon, and place the tesseræ with their proper faces downwards. The tesseræ are fastened with common paste to sheets of coarse brown paper, on which the cartoon is traced. When the work is finished it has only to be fixed with cement upon the wall destined to receive it, and the brown paper is then removed from the face of it. This process requires considerable skill and practice, especially when figures have to be executed, but is perfectly successful. Thus the decoration of any number of square feet of surface can be forwarded from Venice to any part of the world—to America or to India—with safety and at little cost."

To go a little into detail: the studio should always be well lighted and well ventilated.

The workers are under the control of an artist who is also an experienced mosaist—indeed, his qualification for the post is that he possesses a large and varied experience in the practice of mosaic art.

The working mosaists are divided into grades or classes. The workers in the first grade, work on those parts of a mosaic which require the most careful treatment, such as the face, hands and feet of a figure; those in the second grade, work on ornaments and drapery; those in the third grade have given to them the execution of simple backgrounds, and so on—each man being given that work which he is best fitted to perform.

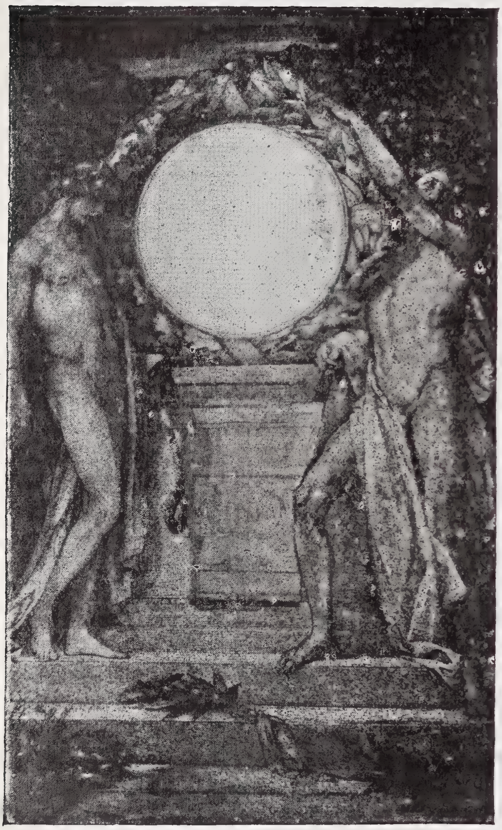
When a cartoon is brought into the studio it is traced and reversed on coarse brown paper. This reversed tracing is then cut up into pieces of irregular shape, and these pieces are distributed among the various grades of workers. The cartoon is then hung up so that it may be seen by all, and the workers, being comfortably seated at their desks with a small anvil, a small hammer, some paste and the enamels they will require by their side, the work begins. Each worker having carefully noted the colours and the size and shape of the tesseræ required for his part of the cartoon, proceeds to cut his enamels accordingly, and to place them with their proper faces downwards on to the plain tracing before him, and to attach them thereto with common paste.

With the exception of the tesseræ used for metal backgrounds (to which I shall refer later on), each tessera is the same in colour throughout, and all the tesseræ are of equal thickness, and are evenly shaped from top to bottom. When, therefore, they are placed on the paper "face downwards," there remains under the eye of the worker the exact counterpart of the work he has executed—the design being carried right through the tesseræ—and he is thus able to judge of the effect of his work, and to make any necessary alterations or corrections as it proceeds.

Metal backgrounds sometimes require a slightly different treatment. Owing to the construction of "metal cakes," the metal is only visible from the front or face of the mosaic. All that the worker can see when he has placed the metal tesseræ face downwards on the paper is the glass by which the metal is backed. In

the case of a plain gold or silver background, no modification of the method is necessary, as the worker, by long experience, knows exactly the effect which is being produced on the face of the mosaic. When, however, a background is to be composed of various shades of gold or gold and silver, a treatment requiring the exercise of great skill and judgment, it is constructed face *upwards*, so that the workers may see the effect of each

FIG. 2.



THE "WRONG" SIDE OF A MOSAIC.

tessera as it is laid; then paper is pasted *over* it, and it is ready to be packed.

On the screen I give an illustration—taken from a photograph—of the "wrong" side of a mosaic executed by this method. It will be of interest to those critics who have condemned the process on the ground that the worker cannot see the effect of his work as it proceeds, and it may be of some interest to others as being the first illustration of the "wrong" side of a mosaic which has ever been published. The interest will be enhanced by the following illustration, which shows us the effect of the "right" side of the same mosaic.

In a very interesting paper contributed by Mr. Clement Heaton to the Journal of the Royal Institute of British Architects, he states that he was told at Venice it was impossible to do figure work without grinding. I do not know from whom he obtained his information, but I can assure him that not one single tessera in this mosaic has touched the grindstone.

FIG. 3.

THE "RIGHT" SIDE OF THE SAME MOSAIC.

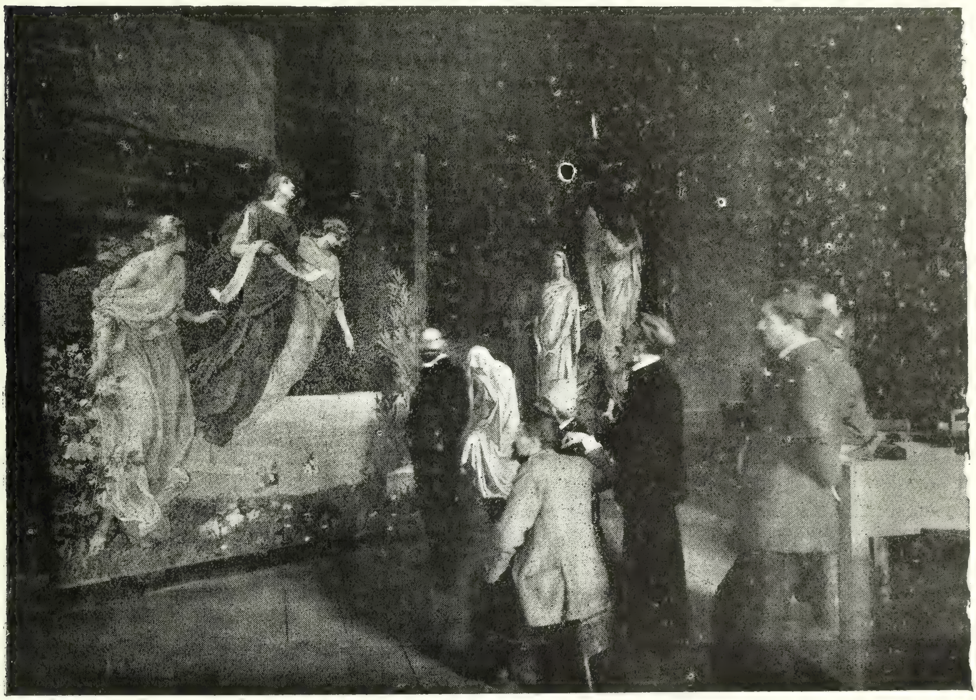
The artist who controls the studio is in constant touch with all the workers, and in the course of his frequent visits to each one, advises or corrects as he watches the progress of the work. It is he who divides the cartoon and distributes the pieces among the workmen; and in this connection it may be observed that sometimes a mosaic is required to be executed by a certain date much within the ordinary limit of time given to a work of the kind. It is impossible to hurry the workers, for that would be detrimental to the quality of the

mosaic. The cartoon is therefore divided into smaller pieces than usual, and a larger number of workers are employed on the work; and by this means, without hurry or injury, the mosaic is executed within the time allowed. Under the old method an expeditious treatment is not possible.

It may seem at first sight as though the employment of many workers on one design would produce inequalities in the workmanship which would mar the harmony of the work; but it must be borne in mind that the superin-

some slight defect in the enamel, so slight as to be unobservable to the worker when placing the tesseræ. Again, enamels which in one light appear to match exactly the colours of the cartoon, when seen in another light produce a different effect. Now, here again we have an advantage over the older method, for the mosaic can be viewed at any angle of light while the work is in progress and before the tesseræ are placed on the wall; and any defective parts can be removed with ease and at little cost.

FIG. 4.



ARTISTS AND WORKERS EXAMINING A MOSAIC BEFORE IT LEAVES THE STUDIO.

tending artist controls the whole work and imposes *his* interpretation of the cartoon on *all* the workers. The slight variations in style which he would permit would only tend to add an interest to the mosaic without in any way disturbing the harmonious blending of its parts.

Practical mosaists know well how difficult it is to avoid the intrusion of bits of enamel, of the same colour and possibly taken from the same cake, which, when seen in a particular light or at a certain distance convey one tint, but in another light or at another distance convey a different tint; this may be due to

When all the tracings forming the cartoon have been covered with enamel they are collected and placed in a frame, so that the whole design now translated into glass, comes before the artist and workers and is again critically examined in various lights. In this final examination the artist has the assistance of all those who have been engaged on the work, an assistance which is of great value to him, for the eyes of the workers, trained by long experience in the practice of their art, are able to detect the least variations in colour, and the chances of a defective tessera escaping their notice are few indeed. When, therefore,

they and the artist agree that the colours of the mosaic correctly interpret the colours of the cartoon, and fulfil the conditions (if any) imposed by the designer, it is passed, packed, and sent to its destination ready to be fixed.

In recent times there has been in certain quarters some carping at this method; but the only important objections—and important only by reason of their wide-spread acceptance—are two:—(1.) That by this method the workmen are working in the dark, so to speak; cannot see what they are doing, and are unable therefore, to correct their work as it proceeds. (2.) That *because* the tesseræ are placed face downwards on to paper resting on a flat surface, the surface of the mosaic must necessarily be flat.

The first objection has been disposed of in the description of the process already given, and there remains nothing further to be added.

As regards the second objection, it is difficult to understand how the fallacy came to be propagated and accepted by many as an article of faith. Even the latest writer on mosaics, Mr. Lys Baldry, in his charming book on "Mural Decorations," repeats it and condemns the method on that ground. Some months ago the Royal Institute of British Architects held a meeting* to hear a paper read on the practice of pictorial mosaics, and the particular objection under consideration was re-stated, with considerable assurance, by the reader of the paper. Fortunately there was present at the meeting the eminent artist, Mr. Walter Crane, whose wide experience in every branch of decorative art had brought him into contact with mosaics executed by this method. He took exception to the statement, though seeming somewhat mystified by the assertion of his friends which contradicted his own experience. Referring to certain mosaics which had been executed from his cartoons by this method, he said:—

"He was very much astonished at the facility with which his designs were reproduced. . . . The tesseræ were given with the utmost exactitude, and the matching of the colours, allowing for difference in translation of the dead colour of the cartoon into the brilliant colours of the glass mosaic, was simply extraordinary; and even when designs were worked on this method *he believed they had some method of giving a little push to the tesseræ, in parts, to get more variation of facet in the gold of the background.*"

* 18th November, 1901, proceedings reported in Journal of the Institute.

Mr. Walter Crane was right. The fact is the placing of the tesseræ face downwards on the paper, does not in any way affect the surface quality of the mosaic which is regulated *at the time the tesseræ are being fixed upon the wall.*

When the mosaic is brought to the wall which is destined to receive it, the wall is prepared with cement, and the pieces into which the mosaic has been divided are taken from their cases, and the work of fixing begins.

If one fixer only is working on a panel, about four feet of mosaic can be placed on the wall at a time. The tesseræ are pressed into the cement, and after a few minutes the paper is damped off and the mosaic discovered. It is at *this* stage that the character of the surface is determined. There is no need for hurry while the manipulation of the tesseræ is proceeding, as the cement used does not set firm for some hours after the paper has been removed; and there is no fear of the tesseræ sagging, as they are laid from the *bottom* and not from the top as in the old method. If, therefore, the designer is also a practical mosaist, and wishes personally to undertake the work of fixing, this method affords him facilities for stamping the work, in its final stage, with his iudividuality by giving to the tesseræ with his own hands that "little push" to which reference has already been made.

To facilitate fixing in localities where skilled fixers are not to be met with, mosaics intended to cover flat surfaces are sometimes set in cement before they leave the studio. The process is as follows:—A bed of cement about half-an-inch thick is laid upon a smooth wooden surface and before the cement has set an iron frame of ingenious construction (the invention of a Venetian) is pressed into it. This is then covered with an upper layer of cement prepared to receive the tesseræ which are placed upon it in the same manner as, by this method, they are placed upon the wall. When the work is completed its appearance is that of a slab of marble, rimmed with iron and covered on one side with mosaics. It can then be placed in position by any competent mason, and for that reason this special construction is suitable for mosaics intended for India or the Colonies. The colossal figure of Minerva in the Library of Congress at Washington was so constructed, and the result is perfectly satisfactory. Large panels are divided into sections, to facilitate packing, and these sections (like the sections into which the cartoons are divided) are irregular in shape

FIG. 5.

MINERVA AT THE CONGRESSIONAL LIBRARY, WASHINGTON.

FIG. 6.

ST. NICHOLAS, EXECUTED FOR THE QUEEN OF ROUMANIA

and follow the lines of the designs, so that when fitted together no joints are visible.

It must be distinctly understood that the "face downwards" method is applicable only to decorative work and cannot be used (to re-quote Sir Henry Layard) when much delicacy of execution and extreme nicety in gradation of tints are required. In such cases the work is always executed "face upwards" and when finished is taken up on to paper from the front. return to the older method, for they know that, by the means they employ, a mosaic of equal quality can be executed at half the cost, and in less than half the time; and so they are content to allow the "battle of the methods" to be fought out in their absence, while they continue to raise higher and higher the standard of quality, being convinced that, with the two masters, time and money, on their side, their views will prevail.

Fig. 7.

One of the Panels in the Church of St. Cecilia, in Trastevere, Rome.

I give here an illustration of a mosaic so treated—a good specimen of the very fine work which can be produced by the Venetians, and an excellent contrast to the decorative mosaic which was last thrown on the screen.

This, then, in brief, is the method which is now known as the Venetian method. For its successful application considerable skill and practice are necessary, but the experimental stage has been passed long ago, and experience has shown that the Venetians are capable of good work. They smile at the notion of a

In the course of this paper I have called the working mosaists "workers" or "workmen," but, in truth, those in the higher grades are entitled to be more suitably designated. They have studied every style of mosaic construction and thoroughly understand the possibilities as well as the limitations of the material with which they work. Their wide practical experience has given them freedom and assurance in shaping and placing the tesseræ, and in adding all those subtle touches which mark the difference between a mere slavish copy

of a design and a work of art. To make my meaning clearer I will read a letter received from Cavaliere Giovanale, Architect to His Eminence Cardinal Rampolla, on the completion of the mosaics recently executed for His Eminence, and now placed in the Crypt of St. Cecilia in Trastevere at Rome; and while doing so I shall ask my assistant to place on the screen one or two of the mosaics to which Signor Giovanale refers:—

"The mosaics are a perfect copy of the cartoons, reproducing with fidelity not only the outlines, but retaining in the treatment of light and shade, and in the expression of the faces, all the intentions of the artist who designed them, and truly interpreting the scheme of colouring expressed in the small sketches which accompanied the cartoons. Nor must I fail to express my admiration, and the admiration of those who have examined these mosaics, at the perfect technique and wise distribution of the tesseræ by means of which all the most delicate effects of modelling and colouring have been obtained. This proves the artistic taste and technical skill of those who executed the work."

Men who can produce work of this kind are, I think, entitled to be called artists, and in this opinion I am supported by the late Sir Edward Burne-Jones who addressed the following letter to the chief of some Venetian mosaists who had executed mosaics from his designs:—

"To the artists at Venice, who have been so indefatigable in carrying out my designs, I owe much gratitude, and I should be obliged to you if you would convey to those who executed the work some expression of my delight at the result of our co-operation, and my trust that it is only a beginning of our labours together. Will you kindly do this for me, because I know their skill and workmanship have been of an unusual kind."

Such words, addressed to them by such an authority, go far to establish the claim of the Venetians to be the best mosaists in the world.

DISCUSSION.

The CHAIRMAN, in inviting discussion on the paper, said that, except for the few introductory remarks on the history of the revival of mosaic work during the past fifty years in this country, Mr. W. L. H. Hamilton's paper was restricted to the technical, and thoroughly practical, but, from his own point of view, rather narrow question of the comparative merits of two methods of mosaic construction: the older, that of fixing the tesseræ on the wall directly, one by one; and the newer, in which the tesseræ were first fixed face downwards on paper, and then fixed *en bloc* on the wall. Mr. Hamilton had argued this question with thorough knowledge, and had placed his arguments before the meeting in the concisest and clearest manner possible, and with a generous impartiality. Of course Mr. Hamilton was all through thinking of mural mosaics, and had not dealt with mosaics in general, any more than with their general history. He had, therefore, and he supposed, intentionally, omitted the earliest of all forms of mosaic construction, followed alike by the ancient Egyptian and the Assyrians, in the decoration of sumptuary furniture, such as ivory thrones, and the incrustation of large jewelry. This method was to chisel the design out of the solid ivory or gold in a series of small sockets in which the pieces of mosaic were each separately held within its own tight socket of gold or ivory. In fact, it was *cloisonnée* work, but with solid instead of fluid colouring materials. Now did not this afford a practical suggestion for the construction of mural mosaics which would present the advantages of both the methods described by Mr. Hamilton? Why should not the decorative or the pictorial design be laid down in cement in a shallow, tray-like frame, in Venice, or elsewhere, and then fixed on the wall for which it was intended, either by means of concealed clamps, or by embedding the whole framed mosaic in cement? He used, in Bombay, to do something like that himself, with living flowers, working out enlarged patterns with them on a wooden framework, for the annual decoration of St. Thomas's Cathedral on Christmas Day in the morning. What Mr. Hamilton had said of the recent date of the revival of mosaic work in England was most interesting; and it was very wonderful, considering how the Romans propagated the art of their mosaic pavements over every part of their wide empire, in Spain, throughout Northern Africa, in Asia Minor, throughout Germany, and in France and in England. The art of mural mosaics reached its zenith at Byzantium; but, of course, the revival of painting, as a fine art, gave the death blow to its extended use. Yet nothing was so effective for the internal decoration of churches as mosaics, decorative and pictorial, and nothing so consonant with the spirit of the historical Christian order of Church service. The Normans, who themselves learnt the art of mosaic work from the Saracens, in the Mediterranean, never introduced it into England; and although there can be no doubt of Wren having intended to use it in St. Paul's, it was really not till about 1851 that the art was revived in this country; and initiated through the cumulative impression made by the discoveries of numberless old Roman mosaics of the type of those to be seen at Cirencester, Woodchester, and York. Mr. Blashfield's work, so far as he recollected it, was based on these discoveries. Of course, the revival of the art of Venetian mosaics was entirely due to the initiative of Salviati, and the encouragement he

received from Sir Austen Henry Layard, and also, let it be added, from Castellani, and Saulini, who, in Italy, warmly welcomed their fellow-countryman's success; and, again, from Lepec, the enameller, in France, and from Robert Phillips, formerly of Cockspur-street, the greatest of the English jewelers of his generation. He had known them all, they had all passed away, and he recalled their names with deep reverence.

Mr. LEWIS F. DAY said that in 1895 Sir William Richmond, at the Society of Arts, claimed that he had killed the paper mosaic, and from that time most people were prepared to think that artistic salvation was to be found only in working from the front. The author had shown in his paper that there was life in the old method yet. Whether it was right or wrong, it was in the interests of all concerned that the two ways should be brought forward and discussed. Sir William Richmond claimed that the method he adopted in working from the front was quicker, better, cheaper, more certain, and more interesting to the artist. Probably it was more interesting to the artist, but he doubted very much whether it was cheaper, quicker, or more certain. The author had given very good reasons for stating that the method of working on paper was more convenient; that it freed the artist from the necessity of lying on his back or side when doing the work; that he could do it without suffering from extreme heat or cold; that he need not wander about the face of the earth in order to follow his pursuit, and that any number of workmen could be put on to a particular mosaic without getting in each other's way. Under those circumstances he thought the author must fairly claim that time and money were on his side. He thought the author had fairly well answered all the objections raised by artists, the first being that the worker did not work in the dark, the tesseræ being coloured all through. He did not think it was necessary that the worker should see precisely what he was doing, because every artist worked towards an end, which he did not see until it grew in completion at the finish of the work. In so far as there was a danger, he thought the Chairman had pointed out the remedy, the practice suggested, which was sometimes used, of doing a little piece on the front and then transferring it. The advantage of working *in situ* appeared enormous, but when a mosaist was working he was nearly always encumbered by scaffolding, the light thereby being excluded, and when the scaffolding was taken down it was too late to alter the design. He thought the author was not certain of his case in regard to flatness. Artists were appalled at the flatness of a good deal of mosaic done, especially in some modern restorations. The mosaics at Ravenna, which were being restored, were being ruined, and that was only one instance out of thousands of miserable flat mosaic which was being done all over the world. It was reassuring to hear from the author that the tessaræ could be manipulated when they were on the wall whilst the plaster was not quite set, and that a little push could be given to the tessaræ, so as to produce an uneven surface. Whether that little push was ever given or not was another question. He thought the general mosaic worker would require to learn a great deal more than giving a little push in order to break the surface of the mosaic and supply that variation of facet which was such a charm in mosaic; but there was no real reason why the experienced decorator should not employ the transfer method which had many practical advantages. In considering the question it was impossible to ignore the conditions of time and cost. The conclusion he drew from the paper was that there were two methods of working and that either method must be followed by the artist according to his genius. Looking into the matter it was apparent that one method had been taken up largely for purposes more or less directly connected with trade, whereas the other method had been taken up by a few artists. Everything really depended upon the artist. A man with no idea beyond making money out of his decoration would be equally dull and uninteresting, whether working from the front or on paper, whereas if an artist with his soul in his work adopted either method and trained his men, the result would be equally satisfactory.

The CHAIRMAN, in commenting on Mr. Day's remark that the inherent effect of the method of laying the tesseræ face downwards on paper did tend to smoothness, said, at the same time, it must be remembered that the designs of Lord Leighton and Sir Edward Poynter at South Kensington, where the mosaic was laid directly on the cement, were spoilt by their smoothness. He believed at the time there was a desire for smoothness, and that the desire for roughness had grown up later. The specimens exhibited, in which the paper method had been followed, showed very considerable roughness of the face with a very pleasing effect.

Mr. WILLIAM BURTON thought that Mr. Lewis Day had stated the conclusion quite correctly when he said it was a question of personal predilection, and that one method was just as good as the other. It all depended on how one went to work. In the old days people did not care how much they paid for the work, and how long it took to do; nowadays it was a question of working for very little pay, and for a very little time. Under those circumstances, there was every advantage in working on paper. In regard to the question raised as to why the new work was so smooth, and with regard to the cartoons at South Kensington, one fact had been omitted, namely, that some of the cartoons were made by Minton. They did not grow out of the true mosaic, but out of the modern method of making dust tiles. So much had been heard of the Venetian

mosaics that it had almost seemed as if there had been no effort at making mosaic in England. As a matter of fact there was a good deal more mosaic made in England to-day than in Venice, aud a great many more men were employed here than in Italy. The people of England were really the first to revive mosaic, not the Venetians. The experiments of Blashfield were made as far back as 1826, and the first patent for making mosaic was taken out in 1837; while the modern method of making tiles by compressing clay-dust was undertaken as a possible method of making tesseræ for mosaic. It was through experiments made by the late Herbert Minton to make tesseræ suitable for mosaic purposes that the modern method of making tiles arose. As it was found that the method of making tesseræ was a difficult one, they followed the idea that if the things were made in large pieces they would be a great deal cheaper to make and fix, and then they commenced making geometrical tiles of considerable size, and to that alone was due the modern development of tiles in this country. Certain other tile makers later on took up the matter of mosaics pure and simple. There were two main faults in all modern mosaic; firstly, that the mosaic pieces were made far too thin, which tended to flatness, and, secondly, that they were laid with far too great precision. Most people tried to hide the joints, instead of emphasizing the fact that the joint was the most important part of the finger-pieces of mosaic, and that it ought to be very much wider than was usually the case. It was to be hoped that architects would learn that in mosaic the idea was not to simulate the perfection of a water-colour drawing.

Mr. R. Phené Spiers expressed his admiration for the extremely clear description of mosaics given in the paper.

Mr. W. H. Burke asked the Chairman and the author what authority they had for saying that all the old mosaic was put on *in situ* and that paper was never used.

The Chairman replied that the ancients did not have any paper, they had papyrus, which would not have been used because it was too expensive and not suitable.

Mr. Burke said that within the last month he had been in Venice, and after very carefully examining the mosaic there, both Mr. John Clayton and himself were strongly of the opinion that the ancients did put a good deal of it on paper, which opinion was supported by the director of the restoration of the mosaics in St. Mark's. He formed the opinion from his experience that it was much easier to arrange the colours in the light than in the dark. Almost all the mosaic done in St. Mark's must have been interfered with, so far as the choice of colours was concerned, by the scaffolding and want of light, and he contended that the subtle colour effects produced could not have been obtained if the work had been carried on with the restricted light, probably candles, available at the time. He had frequently tried to produce mosaics in frames working face upwards, and had found on every occasion that there was no advantage, except where gold was concerned. When a strong colour came by the side of the gold it was as well to work face upwards, because the sheen of the gold had a sensible effect upon the colours put at the side. In many of the mosaics carried out by his firm, where there is strong colour and gold by the side of it, that piece was made face upwards and then turned down, the remainder being finished face downwards. That was the only instance where he had found any advantage in working face upwards. In regard to the surface being regular, when mosaic was introduced, fifty or sixty years ago, art and taste had not developed to their present extent, and at the time of the 1851 Exhibition the people were governed by the mechanical feeling which existed. He did not think the ancients ever attempted to obtain a true surface, but they made the tesseræ very small. He had brought with him some specimens of pieces of mosaic which he collected 26 or 27 years ago when the restorations were going on at St. Mark's, and it would be seen that one of the causes of the old mosaic looking so well was the smallness of the tesseræ. The workers had not attempted to make an unequal surface, but the smallness of the tesseræ, together with their leaving cleavage faces, gave the surface an irregularity which it otherwise would not have had. It would be of great interest if the author could state whether paper was used in that instance. Extremely thick and long tesseræ were used in the pavements of Rome, where they were one and a half inches thick, compared with half an inch at Pompeii. A great deal of the excessive flatness was due to the size of the tesseræ. In one of the pieces in St. Mark's he found the tesseræ never exceeded three-eighths of an inch thick, and that, together with the cleavage surface, gave the mosaic its charming appearance. He had also obtained specimens of mosaics showing that tesseræ made of brick were used.

Mr. Matthew Webb said that Sir Edward Burne-Jones had, by implication, been cited as supporting the method of working from the back, the statement being made that he was gratified with the result. He thought it was only fair to Sir Edward Burne-Jones to remember that it was with reluctance he decided that the work must be done by that method which he felt, at an early stage, for many reasons, was unavoidable, but he would have been glad if it had been possible to carry it out in the other way. Reference had been made to the pictorial development of mosaic. It might be interesting to state that when the mosaic work of Sir Edward Burne-Jones first appeared, he (Mr. Webb) heard Sir Edward state his conviction that it was the growing pictorial

skill and tendency of Italian art which led to the gradual substitution of fresco for mosaic. He thought most present would agree with him that the very skill of the modern mosaist was a danger, that mosaic was fitted for decorative and especially not fitted for pictorial work, and that just so far as mosaic was applied to pictorial art, it would cease to be an art. Delicate modelling was out of place in mosaic, and was not wanted. Reference had also been made to adherence to a very specially prepared coloured cartoon, which left nothing to the workman. That might easily be a danger. The cartoon for the work in the church decorated by Sir Edward Burne-Jones was not the final scheme. Sir Edward at an early stage of the work made a very careful selection of such colours of tesseræ as he thought should be used in the whole scheme of work. He disagreed with previous speakers in their remarks as to the advantage of the push given to the work; he thought it would be mechanical as compared with the individual placing of the tesseræ. Expedition and cheapness were valuable, but they did not necessarily secure Art, and, he thought, had little to do with it. If Art was required in anything they must cease to work for the time being for either expedition or cheapness.

Mr. R. F. Chisholm thought that mosaic should be treated from two points of view, external decoration and internal decoration. What might be good for internal use might be bad when used externally. As a durable material, he thought the flat surface on the exterior would be preferable to the in and out surface caused by the push-back. In regard to the question of setting the mosaic on to paper, he had put it on to wood, tracing the design on the wood, floating the tesseræ with cement on the back. The mosaic was put up much more easily in that way than when paper was used. It was quite possible that the ancients used wood, or some other substance, not paper.

Mr. Hamilton Jackson thought the ancients did not use paper. He believed that on the plaster into which the tesseræ were set, they sketched the colour, because the tracings were still to be seen at a particular place, where they were discovered when the mosaics were being restored. Notwithstanding the difficulties there must have been in selecting the tesseræ and matching the colours, no doubt, in view of the fact that the design was traced in colours upon the plaster the mosaic was executed *in situ*. The difficulties connected with selecting the tint would be nothing like so great as imagined, because it would be found in all Greek mosiacs that never more than three or four tints for each colour were used; and yet a fine effect of colour was obtained. Now-a-days nothing but metallic tesseræ and vitreous paste was used; in the old days the greater part of the mosaic was done with natural stone, and the effect of the latter was very much less garish than the former. The garishness of present mosaics was due to the fact that nothing but vitreous paste was used, instead of following the wisdom of the ancients, and using the various marbles. He was in possession of a small piece of mosaic taken from St. Mark's, showing that the tesseræ were larger at the top than at the bottom, a point distinctly in favour of his contention that the work was done *in situ*. If it was done *in situ* it was an advantage to have tesseræ with a point; if not, there was not much advantage. He fully agreed with Mr. Burton's reference to the extreme importance of the mastic showing between the tesseræ; it gave a general tone to the whole mosaic, out of which the details of colour sparkled.

Mr. Philip Newman congratulated the author on the excellent discussion his paper had evoked. Evidently, there was a very divided opinion as to the method in which mosaic should be constructed. The question was whether mosaic should be made on the face or on the back. Arguments had been brought forward showing that in ancient times mosaic could not have been made on the back, because there was no paper. There was no paper also for the stained-glass workman, but he managed with a board, and he had no doubt that if the mosaist of those days worked at all he worked on a board. It was quite a mistake to suppose that in working on the face it was impossible to see in a church, because one was hampered by scaffolding and absence of light, and that one worked from a cartoon very much better. He thought Mr. Matthew Webb had disposed of that question by referring to Sir Edward Burne-Jones's practice of dealing with the cartoon. For the last three years he had been working in a church in the dark, because there was no electric light or gas, but he had to use paraffin lamps. The common-sense view of the matter as it occurred to him was to begin with the highest light and work down from that. He had followed that practice, and the result had pleased most people. He was perfectly convinced it was a far better way than working on a board or paper face down, because one could see what was being done and modify the mosaic. With the method of beginning with the highest tone success could be achieved in a way which could not be secured by working face downwards on a board or a paper.

On the motion of the Chairman, a vote of thanks was accorded to Mr. Hamilton for his paper.

Mr. Hamilton, in reply, after thanking the meeting for the vote of thanks, said the Chairman had asked why the tesseræ should not be fixed in trays in cement? That was done in some cases. It was very suitable where mosaics were intended to cover flat surfaces, but they could not be fixed in such a

way if used on curves. In regard to the thickness of the tesseræ, it was not, as a rule, as much as half an inch, being about a quarter of an inch, or a little more. The coloured tesseræ bore the test of time very well. Together with Mr. John Clayton, he visited the Albert Memorial, a short time ago, and found that although the golden tesseræ had suffered very considerably, the coloured tesseræ were as perfect as on the day they were fixed, about 30 years ago, exposed as they had been to the four winds of heaven at the height of 100 feet. It meant that the tesseræ were sufficiently deeply imbedded in the cement to remain there as long as the cement remained. The Chairman had alluded to schools being established in the country for mosaics. That, no doubt, would be a very excellent thing, but it looked very far into the future. Attempts had been made in different countries to establish schools of mosaic, but none of them had met with great success. There had always been mosaic ateliers in Rome for the purpose of doing the repairs necessary at St. Peter's, and similar institutions in Russia to repair many mosaic works there in existence. One would have imagined that those would have been very good schools; and yet the Government of Russia, when they wanted to decorate the mausoleum of Alexander II., sent to Venice to have the mosaics executed, and Cardinal Rampolla sent to Venice when he wished to have his mosaics executed in Rome. That did not look as if the schools were altogether successful. Mr. Day had stated that although a little push could be given he thought it was not often done. He thought mosaists would agree with him that it was much easier to make the surface of a mosaic rough than smooth. The tesseræ were placed in the moist cement, and unless they were beaten in very hard it was impossible to get anything like a smooth surface. It was an extremely difficult thing to get. When it was stated that the mosaics which were executed by the new method, were so flat, it was because the artist who had designed the cartoon had requested that they should be flat. For instance, the mosaics under the dome of St. Paul's were executed from the design of Mr. Alfred Stevens and Mr. Watts, and in making the background flat, his firm had followed the instructions of the artists. There was no flatness in the mosaics in the Houses of Parliament made from the cartoons of Sir Edward Poynter, but in that case again his firm followed the instructions of the artist. No instructions were given to make them flat, in fact, quite the other way. It was possible to make any surface one liked, and, of the two, it was easier to make a rough surface than a flat one. In regard to Mr. Burke's challenge as to what his authority was for making a certain statement, he thought if Mr. Burke would read the passage he would find it was written in very tentative language. If there was any authority which could be relied upon to show that the ancients did use the paper method, he would be very readily convinced. His firm did not cut tesseræ by machinery; it was the last thing they would think of doing. Mr. Newman had stated that he succeeded in making mosiacs by artificial light. That was, no doubt, possible, but there must be attendant difficulties, because it was obvious that a glass enamel would give out one tint in a yellow light and another in a blueish light. If the mosaist was working by artificial light he must know his colour very well indeed before he placed it in position, otherwise the colours would become somewhat mixed. The first point in connection with the new method was that there was always a good light by which to work. It had also been said that it was possible to see the effect of mosaic even when it was shrouded. He had been making some experiments on the Albert Memorial, and it was so impossible to see from a distance, through the scaffolding, the effect of the experiments being made, that the panels had to be brought outside the scaffolding, in order to obtain a good idea of the mosaic.

Correspondence.

INDIAN INDUSTRIAL ART.

It is disappointing to find the remarks of the Viceroy of India on native industrial art, copied in the *Journal* from the *Times*, have passed without comment from any of your numerous readers.

Lord Curzon's almost despairing tone when speaking of the present position and outlook, engenders the hope that the persistent policy of conservation is to be abandoned, that beaureaucratic conservatism is to give place to the free and more vigorous policy of commercialism, that the arts and handicrafts of India will be henceforth developed on lines different to those favoured by the band of well-meaning, but, in my opinion, misguided enthusiasts who have hitherto held the reins. The Government of India has lavished honours on these gentlemen, and spared no expense in furthering their views, and the actual result, long since foretold, is Lord Curzon tells us: "The progressive deterioration and decline of all arts and handicrafts."

With the salient features of the case, such as they are, could it have been otherwise? On the one hand, a small band of purists armed with a knowledge of the subject not altogether above suspicion, urging the native artizan to keep to his old forms; to continue to make teapots which will not hold hot water, and half-burnt rubbish of all kinds, because these articles exhibit the luscious blues of oxide of copper; shields which could not resist the poke of a spike; swords which would double up at the first thrust! and a host of articles once useful, but now mere vehicles for artistic display! On the other hand, that irresistible body, the public, demanding

something useful for their money. The unfortunate native artizan, thus torn in two, seeing meanwhile the actual markets flooded with English, American, German, and French goods, sought more lucrative employment, and left the solution of this impossihle problem to less skilful hands. If commercialism alone had ruled the Government policy, terrible mistakes would have been made, but the manipulative skill, the real valuable element worth conserving, would have been preserved, and nothing but a curious form of conceit on the part of those urging conservation, justifies the assumption that the art instincts of the people, which produced such admirable works, would not, in process of time, again assert themselves, and more than recover lost ground.

Here in England, in our midst, where a large section of the public understand and appreciate beautiful arts, it has been found impossible to conserve even the best of them. The beautiful art of etching on copper-plate succumbed to steel engraving, and this in its turn died before etching, when the process of steel facing copper was invented; and both these arts have now passed to give place to photographic processes. In the face of such facts as these the attempts to conserve native Indian art industries by æsthetical and poetical talk at art exhibitions seems eminently unpractical.

I do not quite see why Lord Curzon alluded to "Tottenham-court-road furniture." Unless great changes have recently taken place, the Government houses in Calcutta, in Madras, and in Bombay, would be much improved by a few additions from Messrs. Maple or Shoolbred, and I can add with greater certainty, that, fortunately for the comfort of the inmates, neither one of these three houses contains a single purely native-made bedstead, or native-made chair; either such things do not exist, or Government sets a bad example. Neither can I understand Lord Curzon's allusion to "cheap Italian mosaic." Mosaic is one of the most ancient and beautiful arts the world has yet seen, it supplants no purely native art; it is admirably adapted to the manipulative skill of the native workman, being closely allied to the Florentine Art which has found so firm a footing in Agra; but it certainly has not the merit of being "cheap!" The cheapest piece of this work I executed in India, a floor measuring about 80 feet by 54 feet, cost, in English money, £7,600!

R. F. CHISHOLM.

General Notes.

USE OF THE WORD PHONOGRAPH.—In the number of the *Journal* for October 16th, 1863 (Vol. XI., p. 747), there is a notice of a machine called the electro-magnetic phonograph, "capable of being attached to pianofortes, organs, and other keyed instruments, by means of which they are rendered melographic, that is, capable of writing down any music that is played upon them." The writer does not refer specially to the word or say whether it had been previously used apart from the word phonography.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock:—

FEBRUARY 11.—"The Port of London." By Dr. B. W. GINSBURG. ALDERMAN SIR JAMES THOMSON RITCHIE will preside.

FEBRUARY 18.—"Three-Colour Printing." By HARVEY DALZIEL. CARMICHAEL THOMAS will preside.

FEBRUARY 25.—"Tonkin, Yunnan and Burma." By FRED. W. CAREY, late H.B.M.'s Acting-Consul at Szemao, China.

Dates to be hereafter announced:—

"Existing Laws, By-laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions." By T. BRICE PHILLIPS. (Fothergill Prize Essay.)

"Oil Lighting by Incandescence." By ARTHUR KITSON.

"The Use of Electrical Energy in Workshops and Factories." By ALFRED C. EBORALL, M.I.E.E.

"Modern Bee-Keeping." By WALTER FRANCIS REID, F.C.S.

"Education in Holland." By J. C. MEDD.

"Preservation of the Species of Big Game in Africa." By E. NORTH BUXTON.

"Fencing as an Art and an Historic Sport." By EGERTON CASTLE, M.A.

"The River Thames and the Desecration of the Picturesque." By J. ASHBY-STERRY.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock:—

FEBRUARY 26.—"Gleanings from the Indian Census." By JERVOISE ATHELSTANE BAINES, C.S.I.

MARCH 12.—"The Currency Policy of India." By J. BARR ROBERTSON. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

APRIL 23.—"The Province of Sind." By HERBERT MILLS BIRDWOOD, C.S.I., M.A., LL.D.

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 or 5 o'clock:—

FEBRUARY 10, at 5 p.m.—"Women in Canada." By the COUNTESS OF ABERDEEN. The RT. HON. LEONARD H. COURTNEY, M.A., LL.D., will preside.

MARCH 3, at 4.30 p.m.—"The Uganda of To-day." By HERBERT SAMUEL, M.P. Sir HARRY H. JOHNSTON, G.C.M.G., K.C.B., will preside.

MARCH 31, at 4.30 p.m.—"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo.

MAY 5, at 4.30 p.m.—"The Lagos Hinterland: its People and its Products." By MAJOR J. H. EWART.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock.

FEBRUARY 17. 8 p.m.—"Heraldry in Decoration." By GEORGE W. EVE, A.R.E. LEWIS FOREMAN DAY will preside.

MARCH 17. 4.30 p.m.—"Artistic Fans." By MISS HANNAH FALCKE. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

MAY 19. 4.30 p.m.—"The Mounting of a Play" (Stage Costumes and Accessories). By PERCY MACQUOID, R.I.

Messrs. James Powell and Sons have kindly invited the Applied Art Section to visit the Whitefriars Glass Works, Tudor-street, E.C., on Tuesday evening, April 28th, from 7.30 to 10.30 p.m. A short paper on "Modern Table Glass" will be read by Mr. Harry Powell, and the processes of glass blowing will be explained in the glass house. The number of visitors will be limited to 100. Further particulars will be announced later on.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

JULIUS HÜBNER, "Paper Manufacture." Four Lectures.

LECTURE II.—FEBRUARY 9.—Soda recovery—Manila hemp—Jute and other raw materials—Mechanical wood pulp—Wood cellulose—Beating—Sizing—Loading—Colouring.

LECTURE III.—FEBRUARY 16.—Stuff-chest—Regulator — Sand-tables — Strainer — Hand-made paper—Fourdrinier paper machine.

LECTURE IV.—FEBRUARY 23.—Single cylinder and other types of paper-making machines—Finishing — Cutting—Statistics—Paper-testing—Experimental paper making.

PROF. J. A. FLEMING, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." Four Lectures.
March 2, 9, 16, 23.

W. WORBY BEAUMONT, Mem.Inst.C.E., "Mechanical Road Carriages." Four Lectures.
April 27, May 4, 11, 18.

MEETING FOR THE ENSUING WEEK.

MONDAY, FEB. 9...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Julius Hübner, "Paper Manufacture." (Lecture II.)
Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. William Woodward, "Some of the Difficulties which present themselves to the Architect and Surveyor Practicing in London"
Geographical, University of London, Burlington-gardens, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Dr. W. H. S. Aubrey, "Diseases and Doctors in the Olden Time."

TUESDAY, FEB. 10...SOCIETY OF ARTS, John-street, Adelphi, W.C., 5 p.m. (Colonial Section.) Countess of Aberdeen, "Women in Canada."
Royal Institution, Albemarle-street, W., 5 p.m. Professor Allan Macfadyen, "The Physiology of Digestion." (Lecture V.)
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. David Carnegie, "The Manufacture and Efficiency of Armour-piercing Projectiles."
Photographic, 66, Russell-square, W.C., 8 p.m. Annual Meeting.
Anthropological, 3, Hanover-square, W., 8½ p.m.
Colonial Institution, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Mr. B. H. Morgan, "The Trade and Industry of South Africa."
Medical, 11, Chandos-street, W., 8½ p.m.
Asiatic, 22, Albemarle-street, W. 4 p.m.
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, FEB. 11...SOCIETY OF ARTS, John-street Adelphi, W.C., 8 p.m. Dr. B. W. Ginsburg, "The Port of London."
Sanitary Institute, 74a, Margaret-street, W., 8 p.m. Discussion on "The present Shortage of Water available for Supply," to be opened by Mr. W. Whitaker.
Japan Society, 20, Hanover-square, S.W., 8½ p.m. Mr. R. A. McLean, "The Finances of Japan."
Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.
Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

THURSDAY, FEB. 12....Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 6 p.m. Dr. C. W. Pearce, "The Songs of Schubert and Schumann."
Royal Institution, Albemarle-street, W., 5 p.m. Sir Clements Markham, "Arctic and Antarctic Exploration." (Lecture II.)
Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on "The Metric System," and on Messrs. Scott and Esson's papers.
Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, FEB. 13...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Professor Sheridan Delepine, "Health Dangers in Food."
Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. H. A. Bartlett, "The Construction and Setting-out of Tunnels in the London Clay."
Astronomical, Burlington-house, 5 p.m. Annual Meeting.
Clinical, 20, Hanover-square, W., 8½ p.m.
Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m. Annual Meeting. Address by the President.

SATURDAY, FEB. 14...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Mr. A. B. Walkley, "Dramatic Criticism." (Lecture II.)

Journal of the Society of Arts,

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FRIDAY, FEBRUARY 13, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, February 16, 8 p.m. (Cantor Lectures.) Julius Hübner, "Paper Manufacture." (Lecture III.)

Tuesday, February 17, 8 p.m. (Applied Art Section.) George W. Eve, "Heraldry in Decoration."

Wednesday, February 18, 8 p.m. (Ordinary Meeting.) Harvey Dalziel, "Three-Colour Printing."

CANTOR LECTURES.

Mr. Julius Hübner delivered the second lecture of his course on "Paper Manufacture" on Monday evening, 9th inst.

The Lectures will be printed in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday Afternoon, February 10. The Right Hon. Leonard Courtenay, M.A., LL.D., in the chair. The paper read was "Women in Canada." By the Countess of Aberdeen.

The paper and report of the discussion will be published in a future number of the *Journal.*

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, February 3, 1903, 4.30 p.m.; Professor William Garnett, M.A., D.C.L., in the chair.

The paper read was—

TECHNICAL EDUCATION IN CONNECTION WITH THE BOOK-PRODUCING TRADES.

By Douglas Cockerell.

Book Production.

On every hand we hear of the necessity for technical education. Education that is, that will fit men and women for the special work by which they are to earn their living.

The necessity for this special education has arisen through the death of the ancient craft traditions, with the old apprenticeship system, brought about by the great development of machinery, and the consequent enlargement of workshops and factories, with the resulting division of labour.

Formerly a boy was apprenticed to a master who was a skilled worker in his trade, and who, while working himself, could personally train his apprentice. It was just this personal element that was of such value, and that is now so commonly lacking in the training of young workmen.

Now a boy is apprenticed to a trade, or, more commonly, not apprenticed at all. In either case he is too often left to pick up his trade as best he can, being kept long at some one process, as by that means his work becomes more quickly of value. Workmen are turned out highly skilled in the mechanical side of some one process of a trade, but with hardly any conception of the work as a whole, or with any ideal other than machine-like precision.

When workshops were small, each workman, although he might specialise to some extent, would have a general knowledge of the whole of his craft, and of the relation which his part of the work bore to the work of his fellow workmen in the shop. As, moreover, crafts were formerly carried on in accordance with comparatively simple and slowly changing traditions, and with materials that had been

used and tested by former generations, it was possible for a workman to gain in the course of his apprenticeship and ordinary work, a very fair knowledge of the materials he used, and in most cases of their method of manufacture. When he did not use absolutely raw materials, he would generally be in close touch with the makers of such things as he needed.

With the advent of the mechanical and scientific age, all this changed. Each stage in the manufacture of an article, from the raw materials to the final product, has led in most cases to the establishment of huge industries—industries working it is true to a common end, the production of the finished work, but working for the most part blindly, and almost out of touch with one another. The individual workman, making usually but a fractional part of a fractional part of any piece of goods, is not now able to get, in the course of his ordinary work, any grasp of the whole process, or to see clearly in what relation to the finished article his particular portion stands.

As an illustration, I propose to instance the crafts connected with book production, and to try to show how thoughtfully organised technical schools might help to improve them.

The two main trades concerned with the production of books are those of printing and bookbinding, both sub-divided into a number of classes, and each dependent upon the other, and on a number of crafts besides. The printer is dependent upon the paper maker, type founder, ink maker, &c., and the bookbinder upon the makers of leather, cloth, cord, thread, silk, millboard, &c. All these trades, and many others, are engaged directly or indirectly in book production, all working to a common end, the production of the finished book. Yet, as I will show, they are not working in unison with a common ideal, but too often are working with mistaken aims, which the absence of any efficient co-operation has allowed to grow up. The printer, in most cases, selects his paper, and sets his type almost entirely from his own standpoint, generally considering but little the needs of the binder. Very careful consideration of the weight, and the thickness of paper, and of the size of the sections in relation to the size of the page and the thickness of the volume, is necessary to make a book that is pleasant to handle and to read. Even when the letterpress printer has given adequate thought to these points, his efforts are often rendered futile by the insertion of unduly thick plates. As long as the printed type and illustrations come out clearly, there is too little consideration given to their relation to one another, and to their suitability for binding.

Too often a collection of thick and thin sections interspersed with odd single leaves, and plates like playing cards, are handed to the binder, who has to bear the blame if the bound book fails to open and shut freely. On the other hand, when the printer, by taking every care, produces work faultless as far as his craft is concerned, the appearance of the book is apt to be spoilt by bad folding, or sewing, or by other constructional faults, on the part of the binder.

In the selection of materials with a view to their lasting qualities, the modern elaboration of manufacture makes wise choice extremely difficult. Where a craftsman formerly had the choice of perhaps a dozen materials, the qualities of most of which he knew from experience, he now has hundreds of samples sent him, many of which, being the "latest thing," have never been adequately tested. Too often we find that paper that a few years ago was accepted as the triumph of the papermaker's craft, has changed colour and become foxed. Too often we find that leather, accepted at the time as marking a great advance in the manufacture of that material, has proved worthless and has crumbled to dust under the ordinary wear of a library. It is much to be feared that many books now issued will in a short time develop like defects.

I am not speaking of cheaply produced books, nor yet of such wonders of craftsmanship as the productions of the Kelmscott Press. For the former, the conditions may necessitate the use of inferior materials, though even these might often be more wisely selected; and for the latter the genius of William Morris rose superior to the usual difficulties; but the necessity he found for having special paper made, special types cut, special ink imported, tends to support my contention that the book crafts have gone far astray from the ideal.

To cope with the existing state of things, technical classes have been started in various places throughout the kingdom, but as yet they are working independently of each other, and are in danger of repeating and confirming the errors of the trade due to the want of co-operation between the crafts.

We find here a printing class, there a bookbinding class, here a paper-making class, there a leather school; but no system by which they can interchange ideas and make their mutual needs known to one another. This comes a good deal from the prevalent

system of grouping a number of miscellaneous classes together under one management, because they chance to be held in the same place. It would be better, I think, to connect in each city, under one head, all classes dealing with allied crafts. That is, I would advocate the development of the monotechnic rather than the polytechnic system.

I propose to submit, for your consideration, a scheme for a school, in which the defects of the present system might be avoided.

In order that I may be understood I have had a slide prepared on which the suggested scheme is shown set out (see p. 256). The teaching is divided into practical class work and lectures.

Practical teaching for workmen can only be of value in trades that have not yet become wholly mechanical. There is no scope for such teaching where workmen have been reduced to mere machine minders. In such trades it is the directors of the work that need help, and their needs would be provided for by the lectures.

The practical classes named, classes that is in which actual creative work is carried on, are those now in existence in London. In time other classes might be formed. It is suggested that the students in each class should be limited to those actually engaged in the particular craft taught, and this because it has been found by experience that a craft cannot be successfully learnt entirely in classes, that is, the student cannot, except in exceptional cases, reach a professional standard from class experience alone; while to a man already engaged in a trade, class-teaching has been found to be of the utmost assistance.

The system of close classes has been found to work well in the London County Council's Central School in Regent-street. Of course, if only those professionally engaged are admitted, it is necessary to hold all classes in the evening, as that is the only time that such students can attend.

The classes in my plan are arranged in groups of those most closely allied to one another. In the first group are the printing and illustrative crafts, such as letterpress printing, lithography, wood engraving, photographic reproduction, &c. The students of this group would now and then meet together for lectures and demonstrations on such subjects, the manufacture of ink, the relationship of illustrations to type, the methods of the early printers, &c.

Writing and illuminating stand rather alone; but the students would need to study their special materials, such as ink, pigments, gold, and vellum.

Then there is the group dealing with extra binding, library binding, washing and mending of paper, all open to bookbinders. The students in this group would attend lectures and demonstrations on such subjects as leather, thread, cord, silk, millboard, strawboard, glue and paste, cloth, and the methods of the old binders.

There would be lectures for the entire school on subjects common to all classes, such as paper, with special reference to the needs of each craft. Design and arrangement of type, methods of folding sheets, and inserting illustrations into books, printers' ideals, bookbinders' ideals, methods of casing, &c.

It is suggested that these lectures might be open to publishers and their assistants, or to anyone connected with the production of books, whether students of the school or not.

It would be advisable that the school should be under the direction of a head master, whose duty it would be to see that there was some unity of aim throughout the teaching.

One central school for each allied group of crafts would serve for each large city, but affiliated there might be branch classes for practical work in outlying districts. Students or teachers of these branch classes would be free to attend the lectures at the central school, and to refer questions concerning their work to the experts there.

Attendance at the lectures might be made compulsory for all students holding scholarships from the central authority whether they attended classes at the central or branch schools.

As technical schools seem to be destined, in some measure, to replace the apprenticeship system, perhaps it might be possible, by a judicious use of scholarships, to institute grades for workmen in some slight way related to the old grades of apprentice, journeyman, and master.

The practical classes would be taught by practical craftsmen, and sufficiently high fees paid to attract successful men. The lecturers might, in some cases, be the class teachers, but sometimes the services of specialists would have to be secured. In this there might be some difficulty, for it is a fact that methods of production are so far ahead of careful investigation that in many cases there is very little absolute knowledge about the production of the modern manufacturers. It would be necessary in many cases

to institute investigations into the quality of materials, and for this purpose there would have to be a research department added to the school. Where possible students might be induced to interest themselves and help with this work, but the bulk of it would have to be done by well qualified chemists.

To show the necessity for such work, and its value when done, I will say something of the investigation into the causes of the premature decay of bookbinding leather, held by a committee appointed by the Society of Arts. The preliminary report of this committee has been issued, and has attracted a good deal of notice.

The committee consisted of librarians, bookbinders, leather manufacturers, and leather trade chemists. The leather manufacturers were at first inclined to consider the librarians' complaints of bookbinding leather to be greatly exaggerated. To settle the question a sub-committee visited representative libraries to see the state of the leather bindings. They finding that nearly all leather was badly prepared, and that nearly all books were badly bound, reported that the complaints were amply justified.

Meanwhile, another sub-committee was working at the scientific side of the matter, and endeavouring to discover the causes of the decay. Their report will be found with the other, printed as an appendix to the report of the whole committee, and is of great interest and importance. As a beginning, small rooms were constructed in which samples of leather were submitted for three months to the influence of the products of burnt gas. Some hundreds of samples were tested and tabulated, showing the relative resisting power of the various leathers tanned by various tanning agents.

Other tests were made to see the effect of light, heat, tobacco-smoke, &c., and the results tabulated. In many cases three independent sets of tests were made, one at Wrexham, one at the Yorkshire College, Leeds, and one at the Herold's Institute, Bermondsey, and no result was accepted as conclusive unless confirmed by the agreement of the testing centres. What I want to point out is that before this investigation, although for years the grumbling of librarians about the leather had been heard, there had been no scientific inquiry into the subject, and that the findings of the committee are not recapitulations of known facts, but facts new to science, and are the first systematic endeavour to bring the manufacturer of light leather into direct touch with his ultimate customer, the librarian.

The practical value to the trade of this work is shown by the fact that as a result of the reports some of the largest leather manufacturers in the kingdom have materially altered their methods, and that the authorities of some of the largest libraries will in future order their books to be bound in leather prepared in accordance with the recommendations of the committee.

In the case of leather the fault has been shown to be more the result of want of knowledge on the part of the manufacturer than of any intention to produce an inferior article. Want of knowledge that is both of the results of the processes used and of the needs of the binder and librarian. That the fault was not entirely or principally due to the cutting down of prices was shown by the fact that the most expensive leathers were nearly all condemned equally with the cheaper kinds.

The committee is still at work, there being many points still to be settled, but the work is well advanced, and it is hoped that a final report will be issued during the present year. What is wanted is not periodical investigations, involving an immense amount of work, but one thorough investigation and then some system of research work that will keep the knowledge gained constantly up-to-date. In the leather trade the investigation is being held, and there is permanent research work carried out at Leeds and Bermondsey; but even in the leather trade there is, at present, no permanent organisation to ensure adequate co-operation with the other trades concerned.

There are many materials, besides leather, used in books that need an investigation into their methods of manufacture, and it is with these that the research department of the proposed school might deal.

The system of teaching in the practical classes would be much the same as at present carried on at the Regent-street School of Arts and Crafts. Methods differ slightly, and I will describe briefly the system employed in the bookbinding classes which I have the privilege of directing.

All the students are engaged in bookbinding of some sort during the day, so they come to the class after having worked for eight or nine hours and are consequently often tired and "stale." Most of them are apprentices, varying in age from 14 to 21 years; some few that are journeymen are older.

The students are nearly all free agents, and in spite of the liberal scholarships offered, would not attend the class at all unless they

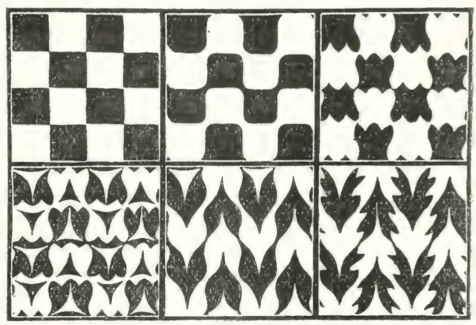
found the work pleasant. A teacher of such a class has first to make the work interesting to the students or he would have no class to teach, and then he must consider how best he can by rousing their interest help them to good work. The teacher should, I think, be professionally engaged in the work he teaches, because in that case he must be learning all the time, and slightly changing his methods and ideals, whereas the ideals of a man who has ceased to work at his craft are apt to become crystalised, and his teaching too dogmatic, and so to lose freshness and sympathy.

All students, regardless of what portion of the craft they may be engaged on during the day, carry out the work of binding books from start to finish. They have all to employ sound methods, but in matters of detail they are encouraged to exercise their own tastes and try experiments. Thus plates and single leaves must be guarded, books sewn flexibly, all slips laced into the boards, and the leather attached directly to the back. These are important constructional points, the right and wrong methods of which can be shown by demonstration. The selection of end papers and leather, treatment of edges, and, within certain limits, the decoration of the cover, being to a great extent matters of taste, are largely left to the students' own choice, and choose they do, often at first with fearful results. After a time, when they have become accustomed to what are to them new methods and materials, and when they have seen the work of the older students, their taste improves, and they see that there are other standards of excellence than those to which they have been accustomed, and come in most cases voluntarily to accept the standard set at the school. Some few never learn, and go on doing hideous things, but they are exceptional. Under stricter discipline, the production of these bad examples might be avoided, but the gain would end there, for the obstinate students would remain unconvinced, and the work of the more amenable would lose the freshness and life that give it any educational value that it may have. What I want to say is that in matters of fact that can be demonstrated you can lay down laws and insist upon their being carried out, but in matters of taste you must lead and not drive. This is, I think, an essential point in successful craft teaching. Certain things must be insisted upon; but, within limits, the student must feel as free as possible. It is as if diverging fences were put up, between which the student must go forward, but within the fences he has absolute freedom, the degree of freedom increasing as he gets further from the starting point. This is a very different thing from forcing him to follow a set line and to copy slavishly set examples.

Students first learn to bind books by what are considered to be the best methods, and when they have bound one or two satisfactorily, they learn to decorate them. There is not time to describe the methods of binding, as I want to say something of the way in which the designing of patterns is taught.

Design may be, and often is, taught from the wrong end; that is to say, fine examples are placed before students for them to copy, and then they are set to produce patterns like them. Or sometimes set shapes are filled with more or less conventional foliage. Both these methods are right if the student has had

FIG. 1.



a thorough grounding in the elements of design, but without this I think they are unlikely to develop original ideas. Design like other subjects must be approached from the beginning, and the more nearly it can be associated with the methods of a craft practised by the student, the better.

Three different masters at the above-mentioned school have developed, independently, systems by which, starting with some elementary form, patterns are evolved by a succession of stages, each varying a little from the one before it, and controlled by some leading principle. Mr. Christopher Whall, the teacher of the glass-painting class, has, perhaps, carried out this system most fully.

Mr. Christie, the teacher of design, employs a somewhat similar method, and I have a slide showing an exercise based on a checker of two colours, the leading principle being here, that of counter charge—that is, that whatever variation is made on the black square in white, is made on the white square in black. Both

these masters insist upon very careful and exact drawings of natural forms, here again making students begin at the beginning, and first make a good drawing of a seed pod or bud, and then little by little they get them to draw, with equal precision, larger forms. Thus students get a knowledge of natural form and experience in arrangement, and under this twofold discipline, produce patterns that are, if not absolutely new, at least new to themselves.

Although many students may start with the same elements, no two ever arrive at the same result. The slightest variation of a line at an early stage will entirely alter the patterns developed later on. At every point there must arise questions as to whether a line is to curve up or down, whether a leaf is to be put here or there, and wherever there is such an alternative open there is a germ of a new series of patterns.

A point worth noting is that although hundreds of patterns are made in each class there is a marked freedom from any vulgarity or coarseness, and although many patterns fail to reach a high level of excellence, all are in their degree pleasant to look at.

In the bookbinding class a somewhat similar system is followed.

Gold tooling is the most characteristic method for the decoration of leather-bound books, and it is chiefly this method that is taught. Gold tooling is the arrangement of the impressions of rigid tools or stamps in gold upon the leather. The tools are very simple, and at first the student merely combines those he selects from the rack at the school. Very few of my students are able to draw at all, but I find that all are able to make pleasant designs with the tools. All are started in the same way; they cut a piece of paper to the exact size of the book to be decorated, and divide it into small equal divisions by some system of crossing lines. The most simple way of dividing the paper is shown on the slide, but it would do equally well if the paper were divided into squares or hexagons. When the paper has been divided up, the student selects a flower tool, blackens it in the flame of a candle, and impresses it at the points where the lines cross. He then puts in a small piece of line below each flower to form a stalk, and a leaf or two on either side to complete a series of tiny conventional plants. This is the first and only set exercise, and is to give the student an idea of the use of the tools, and of the decorative value of simple elements repeated on some orderly plan. The student tools his pattern on a book or on a trial piece of leather and starts a new design. He is quite free to do what he likes, provided the second pattern grows out of the first; he can take his little plant and enlarge it or alter it, but he must follow the same general arrangement.

On the screen is shown a number of the first efforts, and you will see that, although no two of them are exactly alike, there is a very close resemblance between them.

On the next slide we have a series of the second trials. You will see that there is a far greater difference here, and that the individuality of the student has begun to tell. From the second trial he goes on, each pattern differing a little from the one before it, but all having the common line of descent from the first exercise.

The slides (Figs. 2, 3, and 4, p. 255), show books decorated in the class. It will be seen that the common origin of all patterns has been no bar to variety.

Great attention is paid to the arrangement of lettering for the titles of books. All eccentricities are debarred, and words are never split up unless it is obviously necessary. For instance, to put a long word across the back of a narrow book generally necessitates the use of type so small as to be illegible at a little distance. In such cases splitting a word, to permit the use of larger type, is the lesser of two evils. When lettering is put on the side, students are encouraged to design ornament and lettering at once, modifying the ornament to make room for clear, and well-considered lettering.

By designing with the tools themselves, and thinking out the design as arrangements of the tools, patterns are made suitable for the method used, suitable, that is, for gold tooled decoration and for nothing else.

Only well wrought articles are worth ornamenting to any great extent, the presence of ornament being, under healthy conditions, evidence that time on the work has not been stinted, and that the craftsman has had leisure to do a little more than was absolutely necessary to fulfil the utilitarian purpose of the article. Ornament is, as it were, the play of the craftsman, and he must not stint his work in order to play. To decorate a badly constructed book lavishly, is a waste of time. And if, for some cause, such as the want of time or money, some part of the work has to be stinted, then the other parts are best brought down to

the same plane. If we put elaborate work on a worthless, poorly produced book, that after a few years will be of no interest, anyone looking at it will at once feel the undue

FIG. 2.

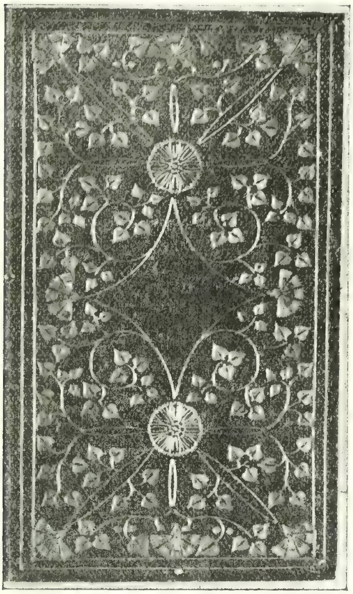
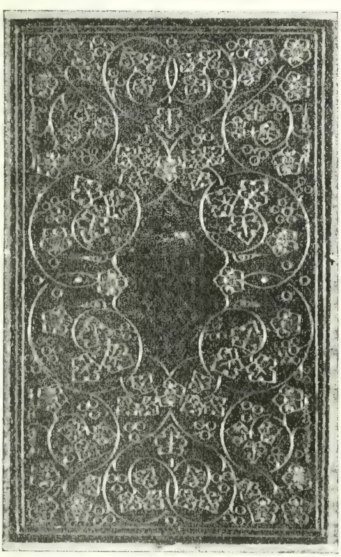


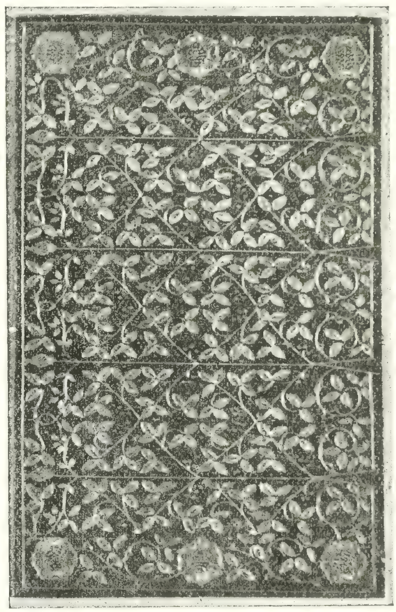
FIG. 3.



importance given to what should be a subordinate feature.

It has become the fashion in some quarters to decry ornament, and to pretend that it shows good taste to admire things absolutely plain. But this preference is an unnatural one. At all times when men have been living naturally, and working for themselves, they have delighted to go beyond what was absolutely necessary to make their work serve its purpose, and have exercised their fancy in adorning it. Thus, a blacksmith, in making a railing, will give a few extra strokes to make his work more pleasant to look at. The harness maker will arrange the sewing in a pattern; the waggon maker will chamfer the edges of his wood, and so on. None of these things add to the usefulness of the articles, but are carried out for sheer pleasure, and to satisfy the universal desire for ornament. This spirit in some other crafts is carried so far that

FIG. 4.



decoration takes the first place, and the construction becomes merely a peg on which to hang it. This is allowable in exceptional cases, with unquestionably valuable objects and materials, and especially in jewellery and other objects of luxury which are, by their nature, ornamental.

I would put in a plea that work should more commonly be judged by the finished result. You often hear such criticism as that a piece of craft work is very well done, but the result is uninteresting. If the result is uninteresting the work is not successfully done. If the execution has become so exact that the result is hard and lifeless, it is not good work. Work is only good that tends to some good

object, to make an article better in some way, more useful, or more beautiful; and work that does not tend to these results is not only useless, but is positively harmful.

Misplaced matter is called dirt, and misplaced plants are called weeds. We seem to need some similar word to indicate misplaced work.

The division of labour as at present carried out, has resulted in the setting up of false standards of excellence. A workman, for instance, who spends all his time in polishing, is not likely to think of the degree of polish that will be best for an article, but to think he has done well when he has obtained the utmost polish possible. He does not subordinate the ideals of his own work to those of the finished production.

Under happier conditions it might be possible, and in exceptional cases it has been found to be possible even now, for all in a shop to work intelligently as one man. In most cases, however, workmen have so little chance of understanding the whole of a craft that they are forced to do the small part allotted to them mechanically and almost without thought for the finished work.

It has been felt by the organisers of the classes of which I have been speaking that a bookbinder understanding ever so imperfectly all the processes that go to the binding of a book is more likely to do his particular part intelligently than when his knowledge is limited to his own work and branch. But besides a knowledge of bookbinding, he should have a general knowledge of the aims of the printer so that he may not spoil the printer's work, and of the limitations of the manufacture of his materials, so that he may not make unreasonable demands upon them. So equally the printer, besides having a knowledge of printing, should have a general knowledge of the needs of the binder, so that he may not put unnecessary difficulties in his way.

It is not suggested that printers should learn to practise paper making, or bookbinding, or binders leather making or printing; but it is suggested that a general knowledge of the needs of these related crafts would be of great mutual benefit and value.

SCHEME OF CLASSES FOR SCHOOL OF BOOK PRODUCTION.

Practical Classes only open to those actually engaged in each particular Craft.	Lectures on Demonstrations to each Group of Crafts on	Lectures to the whole School and outsiders if connected with the production of Books.
Printing— Letterpress Illustrated Crafts Lithography Wood engraving Photo reproduction Allied crafts	Inks Relationship of Illustrations to type Early printing, &c.	Paper with special reference to the needs of each craft. Design and arrangement of letters. Methods of folding paper and inserting illustrations in books. Printers' ideals. Binders' ,, Methods of cloth casing, &c.
Writing and Illumination—	Inks, vellum, pigments, gold, &c.	
Bookbinding— Extra binding Library Washing and mending	Leather Thread cord, &c. Millboards, strawboards, and other materials Methods of old binders	

At present as I have said each craft is taught—as in practice it is carried out—as if it were isolated. The necessity for efficient co-operation is evident, first between the various divisions of each craft, and secondly between the various crafts themselves. The first is to some extent arranged for in the existing schools, but the second seems to be a much needed reform for the future.

In other trades there is quite as much need for well organised technical instruction, and I have instanced book crafts, not because of their exceptional need, but because having to select some group as an example, I naturally

selected those with which I am most familiar.

Such schools as that I have proposed would be the means of establishing a common idea between allied crafts, and of setting standards of work and materials that in time might come to be generally accepted, and so do something towards encouraging the more general production of beautiful and reasonable things for common use.

They would encourage the production of sound materials and of works of handicraft that gave interest and pleasure, because the workman had had interest and pleasure in their making, and of machine-work that, while not apeing the qualities of hand-work, might at the least be an inoffensive makeshift, and, at the best, might have such qualities as good, suitable design, reasonable construction, and well-selected materials can give.

DISCUSSION.

The CHAIRMAN said the subject was well worthy of attention at the present time, whether one was a lover of books, of art, or of man. There were few artistic crafts which offered a better opening for young men and young women than that of bookbinding. A great amount of interest had been awakened in that craft of late years, and the taste of the people was being gradually educated as to what was a really good book—in its paper, its type, its printing, its illustrations, its binding, and its decoration. There was a rising demand for first-class bookbinding and first-class printing. He was glad Mr. Cockerell had brought forward the claims of a great school of book production. But if the industry did not carry with it other branches upon which its success depended, then the success it achieved must be of a very moderate kind. What Clerk-Maxwell called "The cross-fertilisation of the sciences" was a principle which might well be applied to bookbinding. The steam-engine owed much to the contact of James Watt, the scientific instrument maker, with the University professors; and so with many industries the starting point was due to two men who had been working on entirely different lines being brought into contact and comparing their views. He drew a parallel between engineers and scientific instrument makers in this respect, and showed how the necessity for the engineer and the scientific instrument maker, working together on mechanical and, especially, electrical engineering, had brought about a great improvement in both professions, for which especial thanks were due to Sir Joseph Whitworth, Lord Armstrong, and Lord Kelvin. The same sort of cross-fertilisation was required in connection with the development of the artistic crafts. There was a great school at St. Bride's for typography and printing half-tone and other blocks, and collotype; also a school of typography at the Borough Polytechnic and at the Regent-street Polytechnic, as well as a little school which was doing excellent work at the Aldenham Institute, St. Pancras. At Bolt-court, Fleet-street, there was a school for photo-process work, all departments of book illustration, photo-lithography and the like, and a school of photo-process at Regent-street Polytechnic; while in Regent-street there was also the Central School of Arts and Crafts, where students had the advantage of the tuition of Mr. Cockerell, Mr. Whall, and Mr. Christie. There were brought together at that centre teachers of design and craft in various industries. But with regard to book production, bookbinding was almost the only branch taught in that school. He knew of no school of paper making in London at the present time, but at Bermondsey, at the Herold's Institute, there was a school of leather tanning and dyeing, and intercourse had been established between the school for the production of leather and the bookbinding school, through which many valuable results had been achieved. He would like to see an institution in London, which would deal with the production of a book from beginning to end. He wished to emphasise what Mr. Cockerell had said about the desirability of students learning something about other branches of the trade with which he was connected. The country had suffered very much by the narrowness of the education of its workers; many workers seemed to hold the notion that they benefited by understanding only one branch of their trade. Consequently, some years ago, there was a considerable feeling amongst the men of some trades that if classes were established for teaching those trades the classes could be subdivided, according to the practice of the workshop and the factory, and that no man should be allowed to learn anything except the particular branch of the work upon which he was engaged every day. He narrated a very interesting experience of this narrowness at Newcastle, where a drilling-machine minder, when thrown out of employment, had to wait until a similar machine required an attendant. It was not the aim of the projectors of the instruction to produce jacks-of-all-trades, but to ensure that a man who was engaged on a very narrow line of work in the shop should learn all those branches of the industry which were sufficiently cognate to his own, so that the knowledge would be useful to him in his occupation, and enable him to adapt himself to the inevitable changes occurring in it. It was also desirable that he should know the relation of the work which came before and after his own. It had been truly said that the educated man must know something of everything and everything of something, and that could be applied to the educated bookbinder. It was well known that the moneys spent by local authorities in the carrying on

of those classes was expended under the restrictions of the Technical Instruction Acts which provided that they should not teach the practice of any trade, industry, or employment. Occasionally local authorities were attacked because they established classes for bookbinders, and thus were said to have contravened the Statute. There were two answers to that. First, those who attended the classes were bookbinders already, working in the shop, and attended the schools to learn the principles. Thus the labour market was not affected, except that the quality of the labour itself was improved. The second reply was that it took at least five years to make a boy an efficient bookbinder, or efficient at anything; which was about 12,000 hours of practical work. In a course at one of the schools, the time occupied was about 60 to 100 hours a year, at which rate it would take the student about 200 years to learn his trade. By means of classes such as Mr. Cockerell had described, it was possible to do much good in supplementing the teaching of the workshop, and raising the standard of the profession or craft. Mr. Cockerell had not referred to the employment of women as bookbinders.

Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., said he feared it was vain to hope for a revival of the paternal system of apprenticeship for education in the technical industries and trades; but he felt that the highest proficiency in them could only be obtained through it, or some modified form of it, such as having to serve for a period of practical probation before the final certificates of qualification were given. Particularly in the so-called "art industries," in which form, and proportion, and the refined ornamentation and harmonious colouring of the articles produced were part of the consideration in the price paid for them, the direct and continuous personal influence of the craft-master, over the, so to say, affiliated pupil, was absolutely to be desiderated, if the technical skill, and artistic sensibility and individuality of the latter, were to be raised to their highest natural capacity. The present national system of technical instruction—for it conld seldom be described as education—was too centralised, too uniform and monotonous, and, worst of all, altogether too impersonal. There was little genius-inspiring, and no character-forming element in it. The municipal system, including the teaching of the County Councils, and similar public bodies, was more racy of the localities in which it had been established, and more varied, and far more personal and sympathetic; but still that very much depended on the rare accident of the discovery of a craftsmaster of the ability and enthusiasm of Mr. Douglas Cockerell. And then the serious "social" default of both our national and municipal system of education in the higher technical industries and trades is that it does not regulate the supply by the demand. That is what apprenticeship exactly does, and that is its best "social" advantage. He had been much struck by what both Mr. Douglas Cockerell, and the Chairman, Professor Garnett, had said on the other side of this "social" aspect of the question, but he remained of his own opinion still. But how was "up-to-date" teaching to be secured by apprenticeship in such artistic trades, as, say bookbinding? Well, he thought it would be sufficiently secured by the competition of the trade, and by the examples of the masterpieces of the past to be seen in our public Museums, as at the British Museum and at South Kensington [Victoria and Albert Museum], and of the masterpieces of the present at our annual arts and craft exhibitions, as in the New Gallery, Regent-street. Beside it was not after all so very desirable to be in too great a hurry in the production of up-to-date "novelties." We have seen that with the bicycle, we are seeing it with the motor car; and again in the "new art" in its application to architecture and furniture, in both of which he prayed we may have seen the last of it. He thought it would be an advantage in connection with the question of education in bookbinding as an ornamental art, if a little more attention were given to the origin of the present prevailing form of the book; the history of which had been remarkably preserved in the various names that had been given to collected writings that were meant to endure. Now, the question is whether we could not revive, not only with much artistic, but some economic advantage also, both the roll or volume form, and the earlier Roman, and still Oriental, code form—of strung tablets or leaves—of "books." They might be used, he thought, in the case of illustrated works with very great convenience, and good decorative effect on the book shelves. Returning to the question of apprenticeship, if it was now inapplicable to the production of books meant to perish in the using, there was a natural and great opportunity for the revival of the system for the production of books on the artistic elaboration of which —alike of the text, the illustration, and the binding—people were always willing to pay the highest prices. There was a great and growing demand for Church Services, in handy divisions, such as the Order of Matins and Evensong, the Collects and Epistles and Gospels, the Communion Service, the Psalter, the Proper Lessons, the Manual or Book of Occasional Offices, and the Pontificale or Book of "offices" conducted only by a Bishop, &c.; also for such classical books of domestic devotion as the "Preces Privatæ" of Bishop Andrewes. People now-a-day were willing to pay the best remunerative prices for such works, produced in the finest artistic manner; and he would like to see independently formed parochial, and even congregational schools of art, springing up spontaneously in connection with every cathedral, church, and chapel throughout the United Kingdom, for the production of such beautiful books, and other artistic work required in the services of these sacred buildings, and for their devotional adorning. It was in this way that the arts

arose in Egypt, Babylonia, Assyria, Greece, and Italy; and it is in this way that they are still maintained in their pristine proficiency in India—India of the Hindus; and it is in this way only that we may hope to perennially preserve for them in Europe the purifying and exalting inspirations which are at once their participation of divineness and their highest glory. He had listened with lively interest to the reading of Mr. Douglas Cockerell's paper, and much instruction, and he had been greatly gratified by what he had said of the relation of ornament to construction, and the necessity, as a rule, of a strict subordination, of ornamentation to construction. It was because the enthusiasts of the "new art" had not given due consideration to this really vital matter, that they had exposed themselves in some departments of their work to just ridicule. They had made a marked success of their jewelry, because in jewelry the construction really grows out of the ornament, which is everything; while the pin and hook can be soldered on to it anywhere: but a table must have a flat, smooth top, and four firmly set legs,—or three,—or at least a pretended single leg fixed on an extended base; and a chair must be constructed in an analogous manner. To try, therefore, to give the form of a "twirly-whirly" briar bush [the "Just So" "eel" has not yet supplied a "motif" to these young enthusiasts] to chairs and tables, is the mad and egregious excess of enthusiasm after unattainable originality. It could only lead, as it has ever led in the history of the arts, to yet another relapse into the inane vulgarity of trade "novelties;" the apologetic term used by the tradesmen themselves of these wild productions of the astonishing contortionists of the "new art." He felt deeply grateful also to the Chairman for the very suggestive speech with which he had opened the discussion.

Dr. RICHARD GARNETT, C.B., did not agree with the special praise bestowed by the author on 15th century printing. That printing was very fine indeed in some respects, but it was necessary to exercise discrimination. But, whatever fault might be found with modern printing, it had taken a great start, and one could not afford to neglect what was around one, particularly in the use of small, beautiful and compact, but yet perfectly legible type. The need for condensation in the present day had occasioned a great improvement in this respect, and it was well worth the attention of those who studied printing scientifically. He suggested it might be a good feature of instruction to take a past form of type, whether ancient or modern, set the student to examine it, and see what modifications he could introduce into it. That might very well become a stimulant exercise. With regard to ornamental binding, he had been struck by observing the great multiplication of designers who entered in binding and other things, and one felt there was danger of commonplace and monotony creeping in if the basis of design were not widened. It was only necessary to look into natural objects around to see the immense beauty of form ready at hand. In the vegetable kingdom, for instance, there was scarcely a plant which might not afford suggestion to the binder. In the Century Dictionary every description of plant was represented by a very accurate and beautiful plate, and from them suggestions might be drawn. In Smith's Dictionary of the Bible there were illustrations of the plants named in the Scriptures, most of which were of very great beauty, and would afford numerous ideals to the binder and jeweller. In the descriptions of the kingdom separating the vegetable from the mineral kingdom—the *Foraminifera*—were plates containing the beautiful spiculæ which were to be found in those creatures, some of which would require only the slightest alteration to convert them into brooches and pins and other products of the jeweller's art. With regard to the point mentioned by Sir George Birdwood, viz., the fear of overloading the market and getting too many designers, it was remarkable to find how improvement in average bookbinding had limited the demand for fine art. In former days books were bound in millboards, which had the good result, that the possessors of such books had them afterwards bound handsomely. A curious illustration of that occurred in an epigram by Theodore Hook on Shelley:—

> "And excellent reason Bysshe Shelley has found
> To call his new poem 'Prometheus Unbound,'
> For surely an age may be spent in the finding
> A reader so weak as to pay for the binding."

That showed that a book which came bound in boards was not, strictly speaking, bound at all. But if the time should come when publishers would take to issuing their works in paper, as was done largely on the continent, there would be a considerable development for ornamental binding. Such a possibility alone made the study of ornamental binding a very important matter. He agreed with the ill-effect of confining workmen to one particular class of work which rendered him good for that and nothing else; it limited the capacity and stunted the mind.

Mr. CYRIL DAVENPORT regretted that schools of the kind under discussion were not thrown open more than they were. He had been refused admission to the binding classes, though he could not see what harm would accrue from his joining them, and such education would enable him to judge of what was best. He dwelt upon the extraordinarily good designs which, by means of tooling, were produced by students who were ignorant of drawing. He hoped technical schools of the kind would be greatly multiplied, but as the Chairman had said that by Act of Parliament they were not allowed to teach a trade, he could not understand why anyone should not be admitted as a student.

Mr. C. T. JACOBI was glad to hear of the suggested combination of classes, and referred to a series of lectures given at the Northampton Institute, Clerkenwell, the aims of which were to familiarise the worker in any one section with the work of the other departments. He regretted that this example had not been followed up. He was pleased to hear Dr. Richard Garnett speak of modern printing, although he (Mr. Jacobi) was no lover of small type, especially when employed for school books. He had had some experience on examining bodies connected with printing, but found, though the teaching of theory was generally good, it was not always so with the practical part. This was possibly due to lack of equipment. Frequently the form of practical teaching leaned too much to the jobbing class of work rather than that of book-printing, which should be the real standard; for books were intended to be kept, whilst commercial work was but of an ephemeral character. At the present day most apprentices were put to one branch of the trade only, but attendance at a technical school would certainly supplement workshop knowledge. In decorative printing all ornament should be in harmony with and subordinate to the type. Reference had been made to the standard set up by the late William Morris. He (Mr. Jacobi) had probably had as much experience as most printers in that class of work, and would say that general printing offices undertaking such work would find it somewhat difficult, but all could try to elevate the average work of to-day.

The CHAIRMAN said Mr. Davenport would be glad to know that while London continued under the restrictions, the Technical Instructions Act of last session had swept away all those restrictions throughout the rest of the country. So long as it was education, no question could be raised as to whether it was teaching the practice of a trade or industry. One could hope for better things in London some day.

A vote of thanks to the reader of the paper was carried unanimously.

Mr. COCKERELL, in acknowledging the vote, said that the training of young workmen was the most vital matter that had to be considered by craftsmen. The apprenticeship system had failed in large factories, and now if you needed an all-round man you must get a man from the country, who had been trained in a small shop. He considered that thoughtfully organised Technical Schools might help to remedy the defects of the present system of workshop training. In answer to Sir George Birdwood there were no ladies in the bookbinding classes organised by the London County Council. All the pupils were *bona fide* workmen engaged in the trade during the day. He agreed with the idea of going to Nature for *motifs* for design; indeed, that was the only place you could go to. He was not alarmed on the subject of over-production of skilled workmen, so long as the present restrictions as to admittance to the classes were in force. There was a demand for skilled workmen in the book trades that exceeded the supply. As it became increasingly difficult to get an adequate training in the great factories, it would become to be recognised, as a matter of course, that all workmen in certain skilled trades should pass through National Technical Schools. In answer to Dr. Richard Garnett, the study of early printing was put down as an extra lecture subject. Modern printing would naturally be taught and practised in the classes. He was very much against the throwing open these technical classes to any one who applied. Such a course would result in the turning out, at the public expense, of many workmen with a smattering of knowledge of the crafts; their productions would bring the whole system into disrepute.

ADJOURNED ORDINARY MEETING.

The discussion on Mr. DIXON H. DAVIES'S paper on "The Cost of Municipal Trading," read on Wednesday, January 28th, was resumed on Friday, February 6th, the LORD CHIEF JUSTICE, G.C.M.G., Vice-President of the Society, in the chair.

Mr. SYDNEY MORSE said that all would agree with the Chairman in praise of the excellent paper, both in matter and in manner, which was read last week, and he wished to add his great satisfaction that his Lordship had been able to preside. The matter was one of the most important of the day, and it was necessary in the interests of the kingdom that the bes brains and abilities should be brought to bear upon it. Opponents had spoken, and put forward views on the question, and some of them limited their argument to that of abuse, no doubt remembering the old adage, that when they had no case it was just as well to abuse the plaintiff's attorney. It was just as well that those questions should be dealt with by those who were above abuse, and whose lives and abilities and position entitled them to respect. On the last occasion the meeting had the pleasure of welcoming certain members of the London County Council, and although the remarks made by them were not altogether in point, they having overlooked a very important portion of the subject, it was very interesting to hear them. They dealt with the housing question. Mr. Ratcliffe Cousins suggested that the action of the London County Council in altering the figure at which a site should be entered in their books for the purpose of housing the working classes, was improper, and showed that they were not right in their action in the matter. But it did not seem to him that one could accuse the London County Council of what would be called improper municipal trading of

that kind. He thought the true position was, that if a local authority, in pursuance of its duties as a conservator of the public health, cleared an insanitary area, the capital which it expended in that was capital spent on behalf of the inhabitants in the interests of public health, and it should not be put down to municipal trading. Going further into the matter, he felt that when once the municipal body had obtained that site it would be far better if that body were to lease its land to those who were prepared to build workmen's dwellings and manage them, rather than to enter into the building trade in competition with their own ratepayers, and competing with them also in the management of those houses. What was put forward in favour of municipal trading? The real claim was that if traders made profits, why should not the public retain those profits for themselves, and not let them go into the pockets of the traders? That was always put forward as the great point in favour of municipal trading, the object being, of course, to get larger sums of money for expenditure by the local authority. In pursuance of that object the local authorities throughout the country had taken up certain trades. They also said that they only touched those trades which were a necessity for all, and they tried to show that as they were the representatives of all, therefore, anything wanted by all was properly provided by them, and the profits rightly distributed among the ratepayers as a whole. But it was very unfortunate for that argument that municipalities should have commenced with such a matter as electric lighting. Salford, with 35,000 ratepayers, had installed an electric light undertaking, spent a large amount of money in capital, and succeeded in obtaining 401 consumers. In the face of those figures, how could it be said that electric lighting was a thing required by everybody? The result was astonishing. In 1900, Salford made on that undertaking an admitted loss of £2,028; in 1901, the loss was £7,489; and for the last year, the loss was £13,214. Therefore Salford, in order to keep in its own pocket for its ratepayers the profits which the electric light trader would have made, had lost in three years £23,000, and that loss was made in order that 401 of its ratepayers should have the electric light. He ventured to think that if those 401 people had done it for themselves, they would have made a less loss, and would not have paid a higher price. A careful writer in *The Times* had discussed the question of the figures of the last 14 years, so as to ascertain the result. The question he put to his readers was, was it or was it not the fact that those municipalities and local authorities which had embarked on those unproductive undertakings had lowered the rates? The writer took 35 cases throughout the country, in only three o which could it possibly be said that there had been a reduction of rates. The point towards which the municipalities set out had not been reached. But he did not think it was merely a question of whether a local authority made a profit or not; the question was one of broad principle, of right or wrong, not of mere finance. The difficulty of getting at the question of profit or no profit was very large, because borough accounts were not audited by an independent auditor, and if there were half a dozen departments employing officials common to them all, such as the town clerk and the borough engineer and borough accountant, what was there to prevent the local authority from the charging the whole of the town clerk's salary to ordinary municipal duties? That had been done over and over again. Not long ago a case was recorded in which a certain town council was spending £5,000 a year on its borough engineer, borough accountant, and borough surveyors' departments. It had an electric light installation which was bringing in a gross income of £10,000 a year. The charge for that department in three years was respectively nothing, nothing, and in the third year £50. It would be very charming if everyone could have another account to which to charge one's expenses. There were some very weighty opinions available upon matters very ancillary to the present discussion. A Committee of the House of Commons in 1828 said that "they were not disposed to place implicit reliance upon the arguments which had been urged by some public departments against contracts by competition, and in favour of work by themselves. The latter plan occasioned the employment of a great many officers, clerks, artificers, and workmen, and not only added to the patronage, but to the appearance of importance of the department. Nor did the committee suffer themselves to feel any prejudice against the contract system by reference to some instances of failure. They believed that most cases of failure might be attributed to negligence or ignorance in the management of contracts rather than to the system itself." He (Mr. Morse) regarded that statement as of the utmost importance, and very applicable to the present case. But it was pertinent to ask, would it have happened that London would have been without fire prevention facilities, and would the Colney Hatch temporary buildings have been allowed to remain so many years if the County Council had not had other things to attend to? Much of the explanation was to be found in the fact that the energies of many who formed the County Council were detached from their ordinary duties, so that they might deal with matters which, though of great importance, other people could do quite as well, and without any risk to the public. Mr. Birrell, speaking upon that matter the other day, remarked that as far as the ratepayers were concerned, "he did not believe in any millennium for them: they must pay through the nose, either in the shape of rates, or else in the shape of dividends to private speculators." But municipal trading meant that one had to join in every undertaking and to risk the loss, as well as to hope for the profit, which the municipality might, without leave or without any consultation with the ratepayer, impose upon him. Some of the ratepayers might prefer to be without telephones, but the local authority said, "You shall contribute to the telephones if we

choose to put them up." Professor Fawcett, whose opinions were always received with so much weight, said: "The conclusion, above all others, which we desire to enforce is, that any scheme, however well-intentioned it may be, will indefinitely increase every evil it seeks to alleviate, if it lessens individual responsibility, by encouraging the people to rely less upon themselves, and more upon the State," and Cobden said: "The principle I advocate is that the Government shall not be allowed to manufacture for themselves any article which can be obtained from private producers in a competitive market, and that if we have entered upon a false system in this respect, we ought, as far as possible, to retrace our steps. With regard to the possibility of remedies, one was faced by great difficulty. If it was right and proper that a municipality should trade in any commodity, how could one say the same argument did not apply to every other commodity? But surely the remedy was what Mr. Cobden had said in regard to another matter, if a false system had been entered upon, a retracing of steps ought to be carried out. He feared there was no other remedy than absolute prohibition of municipal trading in the future. Municipalities might enter into undertakings which might work out very unfortunately. What about Salford and its losses for instance? What was to happen when local authorities, because of their trading, could not raise money for the absolutely essential sanitary matters which a town required? The matter at the present time was not so new to the public as it was four years ago, and quite recently a very important piece of evidence came to light, showing that the important merchants of the City of London were taking alarm at the extent to which the trouble was growing. He referred to the deputation of shipowners to Mr. Balfour in regard to the port of London. What was said to Mr. Balfour was very significant. They were told that a Royal Commission had reported in favour of the necessary money for the docks being raised on the security of the public rates, and that by so doing the dues and charges of the port of London might be reduced by 2d. per ton. They replied that they would rather pay the extra dues on the tonnage in the port of London than have municipal management of their docks. They said it was absolutely essential that the port should be governed by those who used it, and they thought they were able to take care of themselves and to look after their own business. That was very significant, because, although the reader of the paper had put forward a different view, it was in the City of London where, under adverse circumstances, and under great difficulty, that crusade against municipal trading was started, and it was delightful to see the City coming back to the question and supporting those who objected to municipal trading. It was of no use allowing the dictum to pass that municipal trading in any article was good in principle. It was necessary to look at the question not from the view of whether it paid for the moment or not, but whether it was in the interests of the public, and, above all, in the interests of the working man. In support of municipal trading, the local authorities were saying that they were giving better wages, but what would happen if they gave better wages for a short time, and then the work panned out? If there was no enterprise, work must pan out, invention would be stopped, and then the people who would suffer most were not the capitalists, who could always live upon the income they had made, or upon the interest on their capital, but the working men, who depended for their living upon their regular wage, not upon fitful work, but work which was going on continuously.

Mr. Ewing Matheson thought the matter would be brought into more legitimate form if instead of the word "profit," one used "interest on the money invested." A private shareholder who received four or five per cent. on his money was content with that. The cities and boroughs claimed that they could borrow at three per cent., and he thought a whole evening might be devoted to an exposure of that fallacy, because, though they did borrow at that rate, it was only because they reserved to themselves risks which in private or joint stock concerns would be borne by the companies. In one of the northern towns a large reservoir was made costing about £200,000. They did it a little too cheaply, and when the reservoir was filled the water ran out of the bottom. Seven years afterwards the reservoir was repaired at a cost of £100,000, and only a few months ago it was made secure. The whole of the extra £100,000 was borne by the municipality, and more money had to be borrowed, so that the interest payable by the ratepayers was increased. If the shareholders of a company had been so unwise as to do the work on the cheap, they would have had to have borne the extra £100,000. In the matter of tramways owned by private companies, they had to pay the municipality rent for the use of the road, and had to obey very stringent obligations with regard to the paving of the road, as well as maintaining it; and it would be interesting to know how far in municipal tramways a similar tax on the earnings was imposed or credited to the streets' account. The remark which had been made as to enhancing the importance of the officials of municipalities, was very true, indeed, and he regarded it as the root of the whole evil. The very able men who were town clerks and borough engineers, seeing a limit to their personal advancement, would naturally use every means to augment the dignity of their position, and increase their salary. In a city with which he was acquainted, huge posters were put up by a candidate announcing that, if elected, he would go in for raising the salaries of all the municipal workmen, and that, without regard to the wages they were receiving. The voters to whom that appeal came most forcibly were those who did not pay direct rates, which were included in their rent, so that an extra penny or two in the rates would not be felt by them.

Mr. Walter Bond thought Mr. Davies would set out to show, by a minute examination of balance-sheets, that municipal trading was wrong because it did not pay; but he was glad to find that instead the broad standpoint was taken that though a thing paid it was not necessarily right. The national character itself was affected by municipal trading. As Mr. Morse had pointed out, owing to the methods of keeping the municipal accounts, it was difficult to know just what they meant. A fundamental maxim was said to be that taxation and representation should go together; but this was distinctly violated by the present system of electing municipal councillors, in which ratepayers such as companies got no vote, and others did not get an adequate vote. That became an absolute iniquity if the municipality indulged in trading ventures. Municipal trading simply meant a company in which the directors were not elected by the shareholders, but by their salaried servants, the shareholders being obliged so to be, and being compelled to find the money for the ventures, so as to deprive themselves of their means of livelihood. There was another maxim which municipal trading was fast making out of date. He understood that no man should be a judge in his own case, but municipalities were very much their own judges, and they had very peculiar notions of law. For the recent case at Leeds showed that the municipality licensed their tramcar conductors to overcrowd the cars when they thought it necessary. The stipendiary at that trial remarked, in giving judgment, that it appeared the officials of the local authority had deliberately directed those over whom they exercised control, to violate the very laws of which a printed copy had been distributed for their instruction and guidance; and if so, no language could be too strong in which to condemn such an action. Such events seemed to him to point to municipal chaos. He did not fully join with Mr. Davies's sustained eulogy of private enterprise; he preferred to call it joint-stock enterprise, which was different from private enterprise. Anti-municipal traders forgot that their arguments against municipal trading did not appeal to the average man, because he did not see joint-stock enterprise in all the glowing colours in which Mr. Davies painted it.

Colonel Henry Wilson said a number of very forcible instances had been given by speakers of the evils which had been caused by municipal trading, but the advocates of that kind of trading always came up with instances in which that trading had been successful, or at any rate had not wrought any great mischief. He pointed out that all through business life it was made pecuniarily worth a man's while to put his interest into his work, but that rule did not hold good for county councillors, because they did not suffer if matters went wrong, nor benefit if they went well. There had been, in the last year or two, some very lamentable breaches of trust by members of the legal profession, who had been entrusted with their clients' money. He could not see the difference between them and councillors who extracted money from ratepayers for a certain purpose and devoted it to another.

Mr. H. Springfield spoke as a working man, and declared that, so far from the working man requiring any special economic instruction from the previous speakers, he had a better knowledge of the bearing of municipal trading on the community than most of those who had already spoken. Behind the bread-and-cheese economies put forward on behalf of the capitalist there were forces at work over which they had but little control. The policy now being condemned was being at present carried out by various authorities throughout the country with the acquiescence of the bulk of the electorate. The appeal would have to be made, in the main, to the workmen, who were in the majority, and who looked at the matter first from the standpoint of their interests as work producers. The margin which at present went to the capitalists in the shape of profits, the workmen proposed should be secured by representative bodies for the people, so as to better the conditions of their class, and to give a more efficient service to the general body of consumers. There were thousands of unemployed to-day, and if the capitalist were allowed to continue to hold the reins, there would be a still larger number thrown upon the market. County Councils could do that which no single capitalist, or aggregation of capitalists, could do, namely, carry on industries at cost, and they could give the workman better wages and shorter hours. He asked that the question should be looked at from a broad ethical standpoint. John Ruskin said that country was the wealthiest which produced the largest number of healthy, happy, contented men and women. He challenged a debate on the question from a broad ethical standpoint, because, however big and inflated finances might be, if they were not built upon a sure ethical foundation, down they would come. By associated effort the worker was going to obtain that which the private capitalist would not give him.

Mr. A. A. Campbell Swinton said everybody must sympathise with the last speaker, but he misconstrued the ideas of the people whom he styled generally as capitalists. He (Mr. Swinton) also doubted whether the working man so-called was in the majority. He agreed that it was most desirable that the subject should be inquired into by a Royal Commission. There was a disposition abroad to say that any company which made a profit out of the public was a thief and a robber. If any electric light, gas, or other supply company paid five per cent. it was suggested that the consumers were robbed to that extent, that they should get their supply without any interest on the capital. He (Mr. Swinton) did not suggest that those who promoted municipal trading for their own pecuniary advantage were morally to blame any more than those who, with a like aim, were interested in

private enterprise, but he did not believe the people who were so keen about municipal trading were pure philanthropists, and the public should know the facts. The Association of Municipal Corporations, as also the kindred society, the District Councils' Association, were gigantic big log-rolling concerns, which were engineered by certain firms of Parliamentary agents, who gave a $33\frac{1}{3}$ per cent. commission to the clerks to local authorities who brought business to them. He thought the public generally were not aware of these facts, but they ought to be. He had already brought to the notice of the Committee that sat in both Houses of Parliament the question of these commissions given by Parliamentary agents, and the published evidence given by the authorities supported his views. He thought it most inexpedient that clerks to councils should be pecuniarily interested in opposing or in promoting Bills.

Mr. FRANK DEBENHAM could not agree that municipal enterprises were run by a set of people for their own benefit. If there was one institution in this country more representative than another it was the borough and municipal councils. He agreed with Mr. Springfield that the councils were the servants of the people, and although the experiments—for such they really were—did not always succeed, yet in the long run he thought the right method of conducting such enterprises would be found. He was on the London County Council in its early stages, and he thought the overwhelming majority of the councillors at that time were opposed to the mere idea of municipal trading, yet the forcible eloquence of Mr. John Burns gradually converted them, and London had set a greater example of municipal trading than could be found elsewhere. He referred to the opinion of Mr. Robert Porter, at Birmingham, that England was very much ahead in every respect of the United States in municipal trading. That method of trading was not so much a question of principle as of expediency. In reference to the Port of London, though the City merchants were against the proposal which had been referred to, the London Chamber of Commerce took a different view, and was sympathetic with the idea of the City Corporation lending the money for the purpose. But if the City merchants had taken the interest in the port years ago, which they ought to have done, the question would not have been raised.

Mr. J. H. BUXTON thought the discussion had gone too much into minutiæ, while the broad question had been neglected. No subject was more engrossing, or more deeply interesting, from the statistical and financial points of view, as well as that of good local government. The question was one of private enterprise *versus* municipal enterprise. It was not possible to deal with the question from the standpoint of facts; it must be looked at in a comparative view, to do which one would have to go back into the Middle Ages. It was necessary to ask whether there had been any justification on the part of local authorities for the endeavour to engraft municipal trading upon the corporations which were established for the purpose to which the writer of the paper had admitted they were established. He thought that justification had been proved over and over again.

Mr. C. H. DADE thought the opinions on the subject could be divided into three categories:—(1) Those who said municipalities should not trade at all; (2) Those who said they should trade, and that they should trade in everything; and (3) those who said they should trade, but within limits. If that limit could be satisfactorily fixed the air would be very much cleared. He had sketched out what he thought to be a workable definition, viz., that municipalities should be allowed to undertake the supply of any commodity or service which, in the interests of the whole community, every member should be compelled to use.

Mr. E. M. KNOWLES considered that the suggestion of Mr. Dade opened up an interesting vista of possibilities, because it would include not only water and soap, but clothes and the services of the barber. He thought it a pity that statistics were not procurable from the Local Government Board more modern than those of three years ago, because it was upon those statistics that the case for municipal trading must stand or fall. Again, the financial methods of local authorities were most distracting in their variety. In one municipality, for instance, it was said that there was an enormous increase in its debt as compared with rateable value, but enquiry showed that there had been a wholesale reduction of 25 per cent. in the rateable value of the town. He thought it possible to say that those undertakings only were ripe for municipal ownership which were in the nature of a natural monopoly, and which, moreover, offered no wide scope for invention or development. Electric lighting was in its infancy, and opened up a wide scope for invention and enterprise; and everything which was capable of development should have applied to it the stimulating effect of competition. When a public authority entered into competition with private industry, the tendency seems to be for the latter to retire from the unequal contest. There was recently a by-law of the London County Council requiring any employee who made an invention to surrender it to the public authority. Was it right to expect individual initiative in the face of such a regulation? People argued in favour of municipalising the drink traffic, because under such control there would be less disposition to push the trade, and so drunkenness would decrease. Why should the municipality show any greater inclination to push the trade of supplying electricity? He agreed that the whole question should be scientifically studied, though he did not think Mr. Macdonald's criticism of Mr. Davies's charts was a very happy illustration of the scientific method. The

question touched our social, and industrial life at every point, and did not lend itself to the bludgeon methods of political partisanship, so that time should not be spent in girding at the London County Council, which had done splendid work.

Mr. HAROLD BROWN thought there were one or two points which appealed to business men. Mr. Springfield had stated very nakedly as supporting his case, some fundamental principles which appeal to a very large proportion of the community as being fatal to the system of municipal trading. The employer who had to regulate the extent to which it was to be carried, and the prices which were to be paid for labour and materials, was to be elected by the very people who were to profit directly as employees, or as those from whom goods were to be bought. That, he thought, was fatal to any system of trading which could be devised. The leading principle of companies with which he was connected was that the governing body should be elected by those who had a pecuniary interest in the concern which they were managing. With regard to the circulation of money, one speaker appeared to think that so long as money circulated it did not matter how it circulated. But money which was improvidently spent did not benefit the spender or the receiver in the long run; it was the money which was hard earned that did people good. Mr. Springfield had been very proud to call himself a working man. He (Mr. Brown) had worked as hard for what he had succeeded in making as any horny-handed workman in the kingdom, and he thought the Lord Chief Justice would be disposed to admit the same on his own behalf. The title was not one which the artisan class had a right to arrogate to itself. All people worked for three things: (1) because they wanted to live, (2) because they wanted those who were dear to them to live, (3) because they wanted to save for the old age of themselves and their families. One felt a very strong objection to the spending of money obtained from the community on reckless trading; but did not grudge money fairly drawn and properly spent. The matter must be investigated from the scientific, which was also the humane point of view. Englishmen did not want to go through a crisis of municipal repudiation such as that which took place in America. England was an older nation, and ought to have the good sense to avoid the difficulties into which America fell; but they would not be avoided if matters were allowed to be governed by claptrap on either side. The question should be thoroughly considered before enterprises were launched from which there was no going back. It had been said that improvements in sanitation were due to the action of municipal authorities, but if there was one class of cases which had occupied the law courts during the last twenty years, it had been those in which individuals or small communities or associations of individuals had endeavoured to put pressure upon sanitary authorities to do what was right in those matters, so it was as well to be careful before indulging in general statements of that character. It was said, also, that municipal efforts were experiments, and therefore ought to be tried. Why should they? Each such undertaking was an experiment to the people who carried it out, whether a previous similar one had succeeded or not. Municipal bodies had no business to try experiments, being governments in miniature.

Mr. DAVIES, in replying on the discussion, thanked his hearers for the bright discussion which had ensued, and expressed his gratitude to the Chairman for his kindly words about the paper. He also wished to state his indebtedness to the members of the County Council. He did not understand the criticisms upon his figures; he had not laboured the statistics of the subject, because he agreed that there was so much on the ethical side which was much more important than the mere statistical side. Last time nothing but simple figures were quoted, and they were complained of by the members of the County Council; Mr. John Burns dismissed them with a wave of the hand, and refused to discuss them at all. This time Mr. Macdonald had refused to discuss the figures presented because they were relative figures. With regard to the attempts to define the limits of municipal trading, he did not think it was practicable to draw up a formula which would stand the continual attacks of interested persons who were always desiring to enlarge the functions of officials. It was true that the United States had passed through the fire in that matter; municipalities pledged their public credit for works of all kinds, and quickly outran the constable, with very intense resulting distress. But they stopped it for all time by providing that the indebtedness of any town or state should not exceed a certain relative proportion of the rateable value of the property. He had taken the trouble to apply that method of legitimate indebtedness to the case of almost every local authority in this country. There was no town or county which would not abundantly meet the whole of the needs of its sanitation and police, other than their trading undertakings, within the limit of capital imposed by the United States, which was not far away from the limit of capital supposed to be imposed by the Public Health Act of this country, a limit which was invaded by every private Bill. It was true there must be three orders of efficiency. No efficiency was equal to that of the individual managing his own business. That was somewhat departed from in the case of companies, and very much so in municipal administration. With regard to the remarks as to experiments, the ratepayers were at the mercy of the experimenters, and there was no reason why they should be. The object of the agitators against municipal trading could not be summed up better than it was by Mr. Spring-

field, namely, to secure as much employment as possible. If that gentleman would proceed into the subject he would find that whenever the demand of the community had been left to be interpreted not by the capitalist but by the authorities, invariably the result had been a diminished demand for employment. A typical example occurred when the experiment was tried, absolutely without reserve, in Paris, in 1848. In that city it was determined to start municipal workshops, and the people were to have good conditions, good workshops, and good wages; not very much better than the best outside. The result was that working people throughout France flocked to Paris, and would not work for private employers, so that the latter had to close their establishments, and their credit fell. But while men flocked into Paris there was less work than before the starting of those political workshops. It ended in the street fighting of the Commune, one of the worst social disasters that ever disgraced a civilised country. It was asked why waste of capital by the authorities was complained of? The reason was because the authority did not employ the capital so actively as the private capitalist. With regard to all the improvements of urban life being due to municipal action, he took strong exception to that. For instance, in the matter of water, London would be dipping its buckets in the Thames and the Lea now, if it had waited for local authorities, for practically every water supply system had been started by private enterprise. It was true that water gave but little scope for invention, but where there was that little scope one did not find the authorities making use of it. Hot water supply and the introduction of water under pressure were due to private concerns, not to corporations, so that even water illustrated the defects of public enterprise.

The CHAIRMAN—I now have pleasure in proposing a very hearty vote of thanks to Mr. Davies for his paper. We have all been very much interested in it, and in the debate. I shall not say anything more upon the question, beyond making two observations. I am extremely obliged to Mr. Morse and others for what they have said with regard to my presence here. It has been made the subject of the most extraordinary comments in anonymous utterances, which have been sent me. I never have and never will reply to imputations of motive, to suggestions made as to motives of conduct by anonymous people. And I believe that this audience and the audience last week, whatever side they represent, will take from me what I said the other evening as being the sole reason why I am here. I have not expressed an opinion upon this question at all on either occasion. What I have said is this—and that is the only reason I have been willing to come — It is a very important subject, we have not got sufficient information upon the matter, and I hope this discussion will lead people to call for a real and independent inquiry, and I hope the Society of Arts will join in the demand either for a Royal Commission or for an inquiry. That is the only reply I choose to make, and ever shall make, to those who have thought fit to impute to me unworthy motives in taking the chair on this occasion. Ladies and gentlemen, the debate has shown the interest in the matter, and, whatever our opinions may be, ultimately, it has added very much indeed to the public knowledge; not only the paper itself, but also views which have been brought out in the discussion. I am sure you will join with me in passing a vote of thanks to Mr. Davies for his paper.

The vote was carried unanimously.

Mr. JOSEPH A. JECKELL (Manager Corporation Electricity Works, Coventry), writes:—With reference to Mr. Davies's paper on Municipal Trading. I have read this with very considerable interest, seeing that I have been engaged for several years in municipal trading undertakings. It seems to me that the supporters of municipal trading may be divided into two sections: First, those who like myself believe that where the supply of an article carries with it a practical monoply, and the power to give this supply includes powers to open the highways, it does not seem undesirable that the supply should be in the hands of the municipalities. Secondly, there are those who believe in a municipality supplying any or every commodity if they so desire it. The opponents of municipilisation may be divided similarly into somewhat the same parties. Municipal trading at the present moment exists in the British Isles, and no amount of arguments or statistics will entirely stop it seeing that it is now thoroughly recognised by Parliament. It would, therefore, seem to be much more desirable to use this force as far as possible for the general good of the country and keep it within reasonable bounds by wise safeguards. I notice that Mr. Davies says that the period of the sinking fund which is to be provided varies from thirty to fifty years. He might have gone further. It varies I believe from a hundred to twenty-five. Now, it seems only common sense to suppose that if the equated life of the plant is 25 years in one place it cannot possibly be 50 or a 100 years in other places, and therefore it would seem that there is room to make a recommendation to the Local Government Board, that the period for which the money can be borrowed should be equal in all cases. Intimately connected with this is the question of depreciation. Supposing the money is to be paid in 25 years, there may not be any necessity for a depreciation fund as well, but if the money is not to be repaid under 50 or 100 years there may be very good reason to have a depreciation fund as well as a sinking fund. Personally I would consider that if the money was repaid in 25 years, and the sinking fund were set aside *regularly*

every year, if further, a reserve fund, which is authorised in the Act is made, and up-to-date plant is installed in the station, there is no reason to suppose that any further provision need be made in the way of depreciation fund in the case of municipal electricity undertakings. I am dealing with the question of municipal electricity undertakings, because the opponents of municipalisation have waged war upon this form of municipal trading more than any other. It seems somewhat remarkable that though municipalities had owned gas works for many years there was no outcry against this form of municipal trading. With regard to this question of sinking funds. Certainly, when the Board of Trade statistics are examined, it would appear that there is every good reason for more stringent regulations. On examining the returns it will be found that the percentage amount of fund varies from *nothing*, in the case of two places, to $5\frac{1}{2}$ per cent. in the case of another. Further, a certain electrical paper was in the habit of publishing the Board of Trade returns, with a column in which the surplusses appeared and a column in which the deficits appeared. No manager of an electricity supply works cared to see a deficit standing against his station. Unfortunately these deficits and surpluses were inserted quite regardless of the amount set aside for sinking fund. It is obvious that there is no difficulty in making ends meet by the simple method of not paying your debts. When I was at South Shields I fonnd that while our works were making a bigger gross profit than any others, we were making on the whole transaction a deficit, whereas other places which made less gross profit, made surplusses. They had borrowed their money for the same number of years that we had, and at practically the same rate of interest. On investigation, I found that this was what was taking place. Against the year's accounts when the balance-sheet is made up, there is, of course, charged the stores, the wages, and other charges. There is also charged the interest on the money paid and the interest which has accrued up to the 31st of March, which is the date most financial years end, and in some cases the sinking fund which had been paid had been debited against the year's accounts, but not the sinking fund which had accrued. That is to say, there were two methods, and this was the method adopted at South Shields, but it has since been altered. Supposing the money borrowed on the 1st of April at the commencement of the year was £100,000, and the money borrowed during that year was £50,000, that is to say the debt standing against the undertaking was £150,000 on the 31st March following. The sinking fund which had accrued on the £50,000 borrowed during the year was debited as a charge against the undertaking. Undertakings in other towns were financed in this way. On the 1st of April the debt standing was as before £100,000. During that year a sinking fund was set aside on this £100,000, but as it had only to be set aside *during the year* it might be set aside the 31st March following, but no amount was set aside for the sinking fund, which had accrued on the £50,000. Now the point was, which method was correct? I, therefore, wrote to the Board of Trade, which department is, of course, responsible for the form in which the accounts are made up, and asked their opinion on the matter. They declined to give it, and referred me to the Local Government Board. I then wrote to the Local Government Board, and they would not answer the question, but politely referred me to the Board of Trade. Thus it will be seen that neither Government department would take upon themselves the responsibility of deciding what I venture to think is a very important item. Of course each department should be run as a distinct undertaking, and that has been the way in which I have always managed mine. Personally I should not in the least object to an independent audit of these accounts, and the Local Government Board would, I think, be well advised if they were first of all to make the period for the repayment of loans for the same class of work the same. Secondly, that they should see that sinking funds are actually set aside to the proper amount, because it is suggested, with I believe good reason, that cases have been known where no sinking fund has been set aside. As long as money can be borrowed on such easy terms there is not that reason to look after the capital expenditure that there ought to be, and many municipal electricity supply undertakings are suffering from being seriously handicapped with over-capitalisation. Therefore, if the sinking fund amounts are rigidly adhered to it will bring more prominently before the managers the necessity of keeping down the capital expenditure. One weakness, and a great weakness it is with regard to municipal management, is that municipalitles do not care to pay the management of the undertakings by results. Length of service is the general reason why increases in salary are given, and therefore there is not that incentive to look after the commercial side of the question which would be so much to the advantage of everyone concerned. With many of Mr. Davies's remedies I am entirely in accord. It seems that the credit of a borough cannot be improved by having a big debt, and therefore, all things being equal, it is obviously necessary, of course, to keep down the local authority liabilities. I see that Sir Frederick Bramwell seems to think that the reason that the English manufacturer is behind the German and United States manufacturer in electrical machinery, is because municipalities run electrical undertakings in England. I certainly think that it is not on this account, but on account of many other things, but it is too long a subject to go into now, though one is certainly struck by the much greater and sounder knowledge, with regard to electrical apparatus, which the German manufacturer has over the English manufacturer. His technical knowledge in many cases seems far ahead of the Britisher. With regard to the question of antiquation of plant. Very much depends upon

the far-seeingness of the engineer who designed it. For instance the station at Coventry was designed at the same time as the plant at South Shields, and this was eight years ago, but whereas the plant at South Shields is now in the forefront of modern practice the plant at Coventry is antiquated and would be very much better if it were scrapped. Of course this matter depends upon the engineer and not upon the local authority. They are dependent upon their adviser.

Major G. HURLSTONE-HARDY writes:—The charts, Figs. 2 and 3 of Mr. Dixon H. Davies, exhibiting the ratio of municipal debt to gross rates, seem astounding at first sight, and must have alarmed unwary beholders. The real facts diagrammatically represented are, however, capable of interpretation, obviously different from that primarily intended by their author, namely, an awful warning against municipal trading in the abstract. A cessation of alarm will ensue upon a realisation of the immensely different objects and causes of local debt expenditure, especially where municipalities have acquired freeholds and undertakings which are, in themselves, separately realisable assets of growing value. In no single case do his figures and charts enable one mentally to contract a balance-sheet of municipal estate, liabilities, and solvency. The valuation of town property includes the increment of betterment minus worsement; all this is fairly equitable where the share of local debt is approximately equal to the separate ground-value (or township-site advanced price), although local debt is a practical first mortgage on the whole property. If fundamental necessities, such as drainage, have been costly where house valuation happens to be abnormally low, then the curve would represent matters adversely to a degree far in extent of anything anywhere due to municipal trading. Sheffield, Manchester, Huddersfield, and other towns may, or may not, furnish instances of indiscreet or extravagant municipal trading, but the diagrams do not exhibit anything beyond a presumption that, in some instances, realisable assets of immensely renumerative value may have been secured, whilst on the other hand, nothing possible realisable by sale may have been ventured, but only the benefit gained of some extra expressive undertaking absolutely necessary to the wellfare or existence of the inhabitants and the value of town property. It is a pity that municipal trading never does get discussed without political and logically blind partizanship, and I should have liked, if time had allowed, to have expressed the impressions given to my (impartial) mind by the fatuous appeals to what were called "first principles" and scientific treatment, to which a wrong retort is so commonly given—"all very well in theory, but not in practice." Now trading is too diversely varied in character to be treated all alike, or to be subjected outrageously to doctrinaire dogmas; it is more liable to monopoly, more essential to the community, more national, international, or local in some cases than others. Whilst these facts insufficiently dominated the arguments of the debate, the due recognition of another consideration was quite ignored, namely, that to a great extent modern municipal trading is itself a *genuine form of competition* of which the mere possibility helps to secure favourable terms in the case of large undertakings. Even cases of ill-considered municipal trading have been brought about quite as much as a movement of public revolt against trade raidings on the municipal purse as by municipal ambition, socialism covetousness, or the gospel of collectiveism.

Mr. F. H. WILTSHIRE writes:—I notice in the paper on the above subject read to the members of the Society of Arts that Mr. Dixon Davies seems to score a strong point against municipal trams, in his reference to the North Metropolitan Tramway Company and the London County Council Tramways in South London. I note, too, that in the discussion which followed no one seemed to touch the point. Mr. Davies seemed to prove that by leaving the North Metropolitan Tramways to the old owners of it London ratepayers benefited to the extent of £39,000 per annum, but that the old profits of the Southern Tramways had been frittered away in better wages, shorter hours, and lowered fares. Better wages and shorter hours speak for themselves, but lower fares should speak out trumpet tongued. I am one of the 500,000 passengers by the North Metropolitan Tramway Company in North London, my fare is twopence daily, for the same distance in South London I should pay one penny per day. Thus I pay £1 10s. 4d. more to the private company than I should pay to the London County Council. My share of the £39,000 profit would not reach sixpence per annum. Can Mr. Davies wonder that the average ratepayers want municipal trams.

TENTH ORDINARY MEETING.

Wednesday, February 11, 1903; Alderman SIR JAMES THOMSON RITCHIE in the chair.

The following candidates were proposed for election as members of the Society:—

Ferguson, James, 4, Warltersville-road, Crouch-hill, N., and 91, Fore-street, E.C.

Hamilton, W. L. H., 15, Chepstow-mansions, Bayswater, W.

Hume, John, 18, Chapter-road, Willesden-green, N.W.

Lowry, George A., Board of Trade-buildings, Boston, Massachusetts, U.S.A.

Mackinlay, James W., Chumleigh, Finchley, N., and 85, London-wall, E.C.

Mossop, T., Bond-street-chambers, Bradford, Yorks.
Moysey, Frank Lindsey, 78, Wellmeadow-road, Catford, S.E.
Pyper, William James Stanton, Hollywood, St. Lawrence-road, Clontarf, Dublin.
Riley, Henry Lindon, LL.B., Cant-chambers, St. Helens, Lancashire.
Scarborough, Prof. W. S., LL.D., Ph.D., Wilberforce University, Wilberforce, Ohio, U.S.A.

The following candidates were balloted for and duly elected members of the Society: —

Bland, George, North-park-road, Harrogate.
Devenish, J. A., care of Messrs. King, King and Co., Bombay, India.
Dickie, Archibald Campbell, A.R.I.B.A., 21, Bedford-row, W.C.
Goodspeed, Prof. Arthur Willis, Ph.D., University of Pennsylvania, Philadelphia, U.S.A.
Hamilton, Hamilton, 138, Fremont-street, Peekskill, New York, U.S.A.
Laidlaw, John, 24, Park-circus, Glasgow.

The paper read was—

THE PORT OF LONDON.

By Benedict W. Ginsburg, M.A., LL.D.

So much has been said and written of late on the subject with which I propose to deal to-night, that an apology is certainly due to my audience for this attempt to speak upon it, and not only is an apology tendered, but some little explanation in palliation of my offence must be forthcoming. The Royal Commission, whose report, minutes of evidence and appendices, fill three bulky Blue-books, the Mansion House Committee, and a whole host of writers and speakers, have dealt with the subject, accumulating vast stores of information, and making numerous and varied suggestions as to what may and should be done. I cannot hope to add anything useful to the schemes and suggestions which have been put forward, and would not pretend to do so. But, nowadays, busy men cannot make themselves master of these large reports and bulky volumes. Yet it is incumbent on every one to know something of the question, and it may be useful to have within the limits of such a paper as can be read within an hour, a *résumé* of the position and prospects of this great seaport. If I can succeed in expressing something of the case, I shall have achieved my object. I shall, however, avoid as far as possible discussion of figures and rates, because from those who desire them abundance is already accumulated elsewhere. The treatment of so large a subject in so short a space, must be general, sketchy, and inexhaustive.

It would not be easy to attach too much importance to the problem which is involved in the improvement of the Port of London, which still holds the proud boast that it is the first port in the Empire. Mr. Crawford, of the Board of Agriculture, pointed out in a paper read before the Royal Statistical Society some four years ago, that three quarters of the grain food consumed by the inhabitants of our country comes from over sea. As regards our supplies of meat, he admitted that the proportion of imported to home produced food was certainly less than in the case of grain, but it is nevertheless a very substantial proportion of the whole.

The population of London is now so vast that even if the Thames only served Londoners, and if they only took their ordinary proportion, with the rest of the inhabitants of these islands, of imported food, the mass needed for them would be gigantic enough. But we have to remember two further considerations, both of which have a certain importance. First, that London does not stand quite alone in the Thames valley, for the port is really the front door of some nine millions of persons—double, that is to say, the population of either of the sister kingdoms, Scotland or Ireland, and double that, too, of the great Dominion of Canada. Secondly, it should not be forgotten that the average consumption per head of imported food in a seaport town and its environs, compared with that grown in our own country, would naturally be higher than it would be in inland and agricultural districts.

The question of adequate provision for the cheap and rapid handling of supplies in the port, therefore, affects the food of every inhabitant of this great city, while most of us are affected further in regard to our daily work also, and thus to our earning power. For in every manufacture the cost of the raw material is affected by the cost of transit, and if transit is high, the margin of profit must be reduced, and may, in effect, be brought so low that it may vanish altogether, and thus work may have to be discontinued, as has been seen in the case of that once flourishing industry, shipbuilding on the Thames.

London formerly had one great peculiarity and advantage in its trade. It was the clearing house of the world, not only—as it now very largely remains—in financial transactions, but also in regard to the distribution of goods.

Vessels from all parts of the world came to London, and, discharging their cargoes here, left some part for our own use, and sent the other parts to sea again to be distributed by other vessels bound for other countries. The advantages of the entrepot trade to the community are very obvious and important. It gave the merchant in London a better standing, and it brought ships to the port which would not otherwise have come here; and these ships paid dues, and spent money on stores, and on labour. London owed her entrepot trade to a variety of circumstances, amongst which may be mentioned the advantages which the formation of the river gave her in the old days, the proximity of the port to various Continental markets, and also to the conveniences which, in the old days, the docks were capable of affording to their customers. A century ago, London was an up-to-date port, but whilst things have moved elsewhere, they have stood comparatively still here. But of late, though the volume of the trade of the port progresses—as would seem indeed natural, owing to the increase of population and the increased dependence of our people on over-sea food supplies—entrepot trade is not increasing proportionately. There are, indeed, indications that it is being transferred, in large measure, to the Continental ports, such as Hamburg, Antwerp, and Rotterdam, where large sums of public money are being lavished on works for the improvement of the rivers and docks, and where an immediate return on the money so expended is not looked for, since those who direct public affairs in these places think that the indirect advantages of the trade which is being induced to them, are so great and so beneficial to the whole community, that it is not necessary to show, before making such expenditure, that it will at once return a direct adequate percentage on the full outlay.

In dealing with the port of London one has to remember not only the peculiarity of the trade itself, to which I have already alluded, but also the fact of London's history. It seems at present fairly agreed by every independent person, who has devoted much attention to the subject, that the Liverpool system of dock management is the one which should be set before those who wish to reform and reconstitute the Port of London; but when we remember that the history of Liverpool as a port is comparatively very recent,—since only 200 years ago an 80 ton vessel once a week was about the measure of her trade,—that of London is many centuries old. London depends largely upon the river in a way that Liverpool does not. Not only was the Thames the harbour and port of the city, but it was also, in the days before good roads and railways, the highway and pleasure ground of the citizens. It led to their suburban resorts, and carried large quantities of goods up-country. There were wherries plying on the river almost like hansoms in modern London and gondolas in Venice. These facts have necessarily left their mark on the situation to-day, and have very much complicated the work that lies before us. Liverpool of course had none of these troubles.

Again, the geographical position of London and Liverpool has a very marked bearing on these respective ports. Liverpool is situated at the near entrance to a large tidal estuary which contains a considerable depth of water at high tide. The estuary provides good anchorage and deep water close to the town, and effectively scours out the channel until, indeed, the approaching expanse of Liverpool Bay is reached when the force of the current is rapidly dissipated and the bar of which certain rival ports have made so much is encountered. That, bar, however, though until recently there was not very much water over it at low tide, is relatively very short. London, on the other hand, is situated some forty miles up its river and is approached by an estuary which gradually widens as the sea is reached. The Thames bar differs very considerably from that of the Mersey. What has to be faced here is the dredging of a channel, which, having somewhat similar depth throughout its course, is becoming unequal to modern requirements. This is naturally a more serious undertaking. The shape of the river, and the existence of all kinds of old established undertakings on its banks, complicate the work which lies before the engineers, from the fact that there must be discussions as to the building of training walls and as to the necessary steps to be taken to prevent damage to riverside buildings by the possible slipping forward of the banks when dredging is being carried out.

The old fashioned vessels were able to lie on the hard without sustaining any damage to their fabrics, and it was really the difficulty of adequately protecting their cargoes at low water that led to the erection of the first London docks, just a century ago. An extraordinary picture of the state of things which prevailed at the end of the 18th century, is given in Lindsay's "History of Merchant Shipping." Without going into that, it is

sufficient to mention it, because the high walls of the massive gates of the older London docks show, even now, what was their chief object in offering themselves to traders. The fact is of importance now, because it tends to show that when they first opened, traders who dealt in valuable cargo would be willing to pay high charges for protection, whilst the founders of the dock system would not be particular as to the facilities they were giving to those who alleged that they would be interfered with by the new opposition, with regard to the free water for barges which has so largely stood in the way of recent years.

The dock system, as the Royal Commission points out, divides itself into several classes. We have the older docks, of which I have spoken, and which now seem incapable of much modernisation. These will accommodate vessels of no great size certainly, but it has been proved that their facilities as regards depth of water are in excess of those demanded by any vessels which offer them their custom. The difficulties of navigation in the reaches immediately below them are so great, that there is less and less inclination among ship-owners to risk their approach. It is a question, therefore, whether these docks are worth much consideration at our hands. If generally over-hauled, fitted with modern appliances, and rearranged as to detail, they may well accommodate the smaller class of coast and short-sea traders. For however much the size of big ships increases, there must always be a certain amount of small tonnage. When we come, however, to the docks lower down, we find quite a different state of things. Large vessels use, or at least want to use, the India and Millwall Docks. The Millwall Docks, for example, generally accommodate steamers which bring grain. The typical vessel may be taken as the "M" class of Messrs. Elder, Dempster and Co. These vessels are 470 feet long by 56 feet wide, their gross tonnage about 7,300 tons. They cannot enter the docks at neaps. The Millwall Dock sills cannot be lowered, and therefore it is probable that larger vessels than these cannot, under any circumstances, be dealt with. Now those who defend, or at least attempt to excuse, the present position of the London river, are wont to argue that larger vessels do not seem to demand these facilities. But that may be due to the fact that shipowners are well aware of the limits with which they are surrounded, and have no time to waste in asking for what they know cannot be given them. It is, however, worthy of observation that the Johnston and Leyland lines, which carry large quantities of grain to Liverpool, have found that it is worth their while to build vessels at least 25 per cent. larger than those which go to Millwall. Sir Henry Le Marchant in his very able apology for the docks, and in his plea for a policy of leaving things as they are, remarked that the *Celtic* and *Oceanic* stood very much alone. This was, of course, at the moment, true, but the size of vessels has very materially increased of recent years, and we can no more suppose that the big ships of to-day mark the limit of size than we can suppose that they will not multiply in numbers. Leaving on one side the *Great Eastern*, which was 40 years before her time, we may say that the biggest ships afloat in the later seventies were not more than 450 feet long, and 6,000 gross tons. It was the later eighties before the 10,000-ton ships of 600 feet in length came on the scene, and to-day the 20,000-ton, 700-footer is certainly to be reckoned with by dock authorities. For the carriage of grain especially does this increase of size appear to me to be very important, because the larger the ship, provided, of course, she can get a cargo, the cheaper is the cost of transit. From a paper read two or three years ago by Professor Biles, we learn that for carrying a ton of cargo 5,000 nautical miles, at 12 knots, the cost would be 8s. 6d. in a ship 500 feet long, 7s. 6d. in a ship 600 feet long, and only 7s. in a 700-feet ship, provided she could get the necessary draught of water. It will be seen, therefore, that it is very much to the interest of the ship-owner to build very large ships, if he can rely on filling them, for he may receive the same rate of freight for a cargo in his large ship as for that in a smaller one, and, the cost of moving being less, he retains a larger profit. It is also an important thing for the consumer, which in the case of grain means everybody, because when large ships become the rule, instead of the exception, competition will lower the rate of freight, and give the purchaser the benefit of the economies.

I am afraid I have very much digressed, for the moment, from the Millwall Docks, but I was anxious to meet at once the point of size, and to show how important it was that limits should not be placed upon the size of vessels bringing our food supplies. Should things remain as they are in the Port of London, other ports going ahead, and ships growing as they are, we should eventually find a demand for a class of small ships which should be

able to suit the requirements of London. This class would command a special price, the extra cost of which would come out of the pockets of the Londoners, whilst it is obvious that the fact that such special ships were required would prohibit the continuance of onr entrepot trade altogether. Millwall, then, is limited, as we have seen. We may regard next the India Docks. Here we find that certain small improvements can be carried out which might materially improve the accommodation there, though no big scheme of expansion seems practicable, except, possibly, dockizing the Lea. These docks are still filled by customers at present, and are not considered obsolete by their management. Coming to the lower docks, we find them the most important under the existing system. The Royal Albert Dock, according to the facts stated before the Commission, can take vessels up to 536 feet long, and has about 30 berths at which it can take such. This admission that the Albert Dock can only take ships up to 536 feet long, in view of the table of recent ships which I give, is in itself a sufficient recommendation for the necessity of immediate action.

Of Tilbury it is boasted that any ships now afloat can be accommodated there. It is doubtful, in point of fact, whether the three big White Star vessels could really negotiate the locks. But in any case the distance of Tilbury from London is a very great objection to it. Tilbury lies beyond the range of cartage, and thus in the case of goods bound for London itself, there must be a putting on the rails interposed between the transfer from the ship to the cart. This means, of course, additional expense and the probability of extra damage to goods. It, in fact, makes Tilbury Dock a more expensive place to the dock's customers than a place higher up the river, though the actual rates charged may not show this.

But it does not really meet the requirements of the biggest ships now. For of the four ships ordered some time ago from Messrs. Harland and Wolff by the Atlantic Transport Company, though the three first completed come to the dock, it has been found advisable since the Combine was carried through to launch the fourth as the *Arabic* and run her under the White Star flag from Liverpool.

Of the enormous number of points which are represented by the question before us, I could only think of treating one in detail. That is the Growth of Steamships. It seems to me to be one of importance, even outside London, and it is one, which at all events by London dock directors, does not seem to be appreciated. It gives, too, a measure of the difficulty of properly appreciating the value of the figures laid before the Commission. So I have thought it desirable to add an appendix showing the growth of steamships, and especially of cargo steamships, in recent years, because Mr. Cater Scott and Sir Henry Le Marchant really seem to believe, or, at least, to argue, that London is able to cope with modern steamships in an adequate fashion. My Table might be used, I think, to point a good many morals, some of them not germane to the question before us. But it will be observed from inspection, first that vessels too long for the Royal Albert Dock, first appeared as Atlantic mail steamers which were never likely to use the Thames, and that it was comparatively recently that the cargo steamers appeared. Since their appearance, they have developed rapidly indeed. A new *Celtic* sails to-day, and a third, 28 feet longer than her predecessors, is on the stocks. Secondly, it is remarkable that the effect of the limitations of the Albert Dock have had a very unfortunate influence in retarding the development of shipbuilding, Regard, for a moment, the eight large cargo steamers which the White Star Company has recently built for its Australian and New Zealand trades. The *Athenic* ships, which use the Albert Dock, have had to forsake the old White Star tradition of great length in proportion to their beam, whilst the *Afric* class, which uses Tilbury, has been able to follow Sir Edward Harland's famous design.

Sir Henry Le Marchant tries to make the case of London better by suggesting that Liverpool cannot accommodate the *Celtic* properly. I think here he is mistaken. Liverpool can dock vessels a hundred and fifty feet longer than any that now exist, and that in docks at the centre of her commerce. She never, at any state of the tide, has vessels, however large, on the mud in dock. But if these suggestions accurately portrayed the situation elsewhere, it seems an inadequate view of the importance of the position and of the future, for London the first port of the Empire, and of the world, to urge that other places are nearly as bad as she.

Leaving the docks for a moment, we may turn to the river. I venture to think that a more astonishing position than that of the Thames Conservancy can scarcely be conceived. It has been somewhat severely handled by the Royal Commission, and one cannot be

surprised at the fact. Its revenue is provided from dues, and is a secure and expanding one. In 1894 it received £70,000, rising to £91,000 in 1899. The Board has not been spending within 10 per cent. of its income, and has an unexercised power to spend £100,000. The conditions of the channel of the Thames have long been highly prejudicial to the port. New York and Boston are arranging for 40 feet channels into their ports. German steamers leave Baltimore loaded down to 32 feet. I read the other day of a vessel which left the port of Pensacola nearly down to that draught. Yet a steamer drawing 26 feet may be delayed four hours in the Thames on 310 days out of the 365. If she draws 27 feet there are only two days in the year when she may not be delayed, whilst for one of 28 feet, a delay of $5\frac{1}{4}$ hours may be encountered on any day. This delay, which may be anticipated, is merely perhaps a question of inconvenience and demurrage, though a few hours delay for a ten thousand ton ship run into a considerable loss. There is a much more serious aspect. Vessels arrange to come up the river to catch the tide and dock. A sudden fog, a difficulty with the dock gates (not all of which are provided with the modern hydraulic appliances), or even an unwonted pressure of vessels entering or leaving the entrance, may cause a big ship to miss her chance. Then at peril of being left on the ground, she must fly back 20 or 25 miles for water. In spite of these facts, in spite of what has been called the mandatory recommendation of the Barry Commission of 1894, the suggestions for a 30 feet channel were never even discussed by the Board. The Royal Commission has recommended that the Thames Conservancy be relieved of the duties which it has not performed; and perhaps I need not waste time in going further into the matter, though remarks upon the neglected sources of income, upon the amount relatively spent on office interests and on dredging, and on the antiquated character of the plant provided by the Board, are somewhat tempting.

This policy of the Conservancy has, I think, largely prejudiced the docks. They had little reason to improve their facilities as regards depth of water, when the road to their doors was in so prohibitive a condition; but the dock companies had much more serious difficulties to contend with. The London dock companies have no monopoly; indeed, to obtain existence, they had to pay a statutory price which has entirely crippled them. In other ports the dock owner is master in his own house, in London he is nothing of the kind. In other ports all goods coming within the limits are laid under contribution, in London it is otherwise.

There are, in the Thames a great number of "suffrance wharves" and "legal quays." Those vessels or goods which use these facilities contribute nothing to the dock companies. But there is a far worse trouble even than this. There are some 11,000 barges in the port which are largely employed in shifting goods comprised in the cargoes of ships using the docks. When the first docks obtained their Acts they were obliged to grant these craft the facilities which are contained in what are called "Free Water Clauses." Every Dock Act since has repeated them. By them the barges are empowered to go in and out of the docks at practically their own sweet will. They load and discharge their vessels in the docks, and, unless some small use may be made of the quay, neither they nor the goods contribute a penny to the revenues of the dock. What this may mean is very hard to estimate, but the Millwall Docks reckon that not less than 60 per cent. of the goods imported, and 90 per cent. of those exported, never pass through the hands of the dock people at all. I need not dwell on the trouble which ill-regulated barges cause to the passage of vessels, but the City of London Court is constantly engaged on claims arising out of such matters. A very serious expense is laid upon dock owners by the necessity for allowing barges ingress and egress. The dock gates have to be opened, and are opened, at improper and inconvenient times, and thereby not only is water (which has to be pumped) wasted, but at certain times water containing large quantities of mud in solution is admitted. In the year 1899, these same Millwall Docks dredged 4,783 tons of mud per acre of their water space, and they attribute the deposit very largely to the obligation to provide free water.

Having sketched some of the most salient and most obvious points which call for some action, I would venture, with great humility, to put forward the ideas at which I myself have arrived. It may be impertinent on my part to differ in some degree from so able a tribunal as that which took the evidence which I have quoted, but, at the same time, a private individual feels less responsibility, and may not realise practical difficulties. I would like, in the first place, to suggest that it is necessary

that a port Trust be constituted, and that as far as possible the lines which have proved so successful in Liverpool, should be followed. But it must be remembered that the Liverpool Board was not constituted to re-organise an obolescent port, but simply to administer economically an up-to-date and going concern.

In Liverpool, it must be confessed, absolutely, all the facilities are not in the possession of the Mersey Docks and Harbour Board. Till recently, for example, there was a Duke's Dock, which did not belong to the Board, and, of course, there is the port of Garston. It might, therefore, be urged that a precedent exists in Liverpool for leaving the railway-docks, and such like, out of the scheme. On the other hand, in view of the possibilities of the future, it might be wise to leave nothing which could hereafter prove a thorn in the side of the public authority. Due economy in capital expenditure is essential to success; nevertheless, even if the wharves and legal quays be valued at the highest figure spoken of, it would seem desirable that they should be acquired. The reasons which lead to this conclusion, are two. One, that all goods that come into the port should contribute equally to the revenue; and, secondly, the desirability that once and for all entire control of the waterway should be acquired so that the hands of the Trust may be as free as possible, if it should hereafter appear desirable to carry out some large scheme of river dockization. In acquiring the property of those who now own the Thames docks, it would appear that the price to be paid should be based not upon money expended, but upon returns received. Take the London Dock as an instance. Its capital account has been more or less open over a century. How far expenditure debited to capital has been rightly so debited through three generations, and how far some of it ought to have been charged to revenue, can hardly now be discussed, but we have one point, namely, the value of the land upon which the docks stand. It is said that the original cost of the land was £60,000. Mr. Edwin Fox, of the firm of Edwin Fox and Bousfield, a name whose authority will hardly be questioned, has stated the present value of that land at £1,080,000. His valuation is reached, not by the value of that land for dock purposes, but by looking at its propinquity to the centre. To realise any such price as he puts upon it, it would be necessary to clear the site and use the position for office purposes. No dock authority would dream of spending a million pounds to acquire the site for a small dock which could only be used for limited trade. The holders of this dock security get their return, not on land value, but on the dock's actual capability as a dock. It would seem that their claim to compensation ought to be looked at from a similar standpoint. With the docks, the Trust for the sake of the vendors must take the dock warehouses. It is suggested that as soon as possible these warehouses should be sold or leased, it being thought that warehousing is not a business to be carried on by the London Dock Trust. The objections fail to convince me. The practice of other ports is against these suggestions. The Mersey Docks and Harbour Board has large, well equipped and well managed warehouses. Only recently they have found it desirable to spend a considerable sum of money on a very fine range of tobacco warehouses on the Stanley Dock. Southampton, since the railway company acquired this system, has been equipped with warehouses constructed by the dock owners. I fail to see why the London Trust should be debarred from a branch of business, which elsewhere forms a useful source of revenue to them, and which aids them in maintaining that position of master in its own premises which I believe to be a prime necessity of the case; at all events if it had been urged that the purchase of the warehouses should not be made at all, and that the docks should be taken, and the warehouses left, I think the position might have been argued. But to compel the Trust to buy the warehouses, possibly on terms of forced purchase, and then to compel them to dispose of them at the first possibility, savours to me too much of a policy which has been followed from sentimental reasons by the London County Council in its treatment of those public-houses which it has encountered in its street improvements. This action appears to be a needless sacrifice of public funds.

We have seen that the Commission is not satisfied with the way in which the Conservancy has fulfilled its functions in the past. The scheme which it now brings forward as the action of death-bed repentance is not adequate to the necessities of the case. A 30 feet channel at least 1,000 feet wide as far as the Albert Dock gates must be provided. One thousand feet is a small minimum, because the channel should allow vessels which miss the tide at the docks to swing in the river, and even 1,000 feet would not allow the largest class of vessel to do this with safety.

Whether the Conservancy be entirely relieved of its duties with regard to this part of the Thames, or whether it be continued as an ornamental body, delegating its functions in respect to that portion of it referring to the Trust, as is done in Liverpool, is a detail, but the Trust should certainly be made altogether responsible for the channel, and, that being so, not only dredging, but lighting and buoyage should be amongst its responsibilities. This means that Trinity House ought to be relieved of its functions in the Thames. To this there can be no insuperable objection, as the Mersey Docks and Harbour Board provides for the needs of Liverpool in this direction, and Trinity House would still have plenty to occupy its attention. The Trust ought also to be the pilotage authority, following again the precedent of Liverpool. It need hardly be said that those who form the channel, and indicate its position and limits, are best qualified to supervise those who traverse it. The Corporation has been the sanitary authority for the port in the past, and, in view of the responsibility for the health of this vast population, there is no reason why this should be altered. I have not gone into the archaic question of the watermen and their privileges. The existence of those privileges is one of the things which goes to make London difficult and expensive. The Company of Watermen should be confined to the supervision of their charities. With those comes the question of the barges. The Royal Commission propose that the Trust should license these craft and thus obtain some revenue from them, and attain some control over them. Provided the cost of the license were sufficiently high, these suggestions might fulfil all the requirements of the case, but it is hardly likely that this would be possible, and it would seem far preferable to allow the Trust to make a charge to the barges for the use of the facilities provided, licensing them as well if desirable. Surely it would be better to give some compensation for the loss of privileges to existing barge owners, than to allow a condition of things which has been a scandal to the port, in recent years, to continue. Three most important questions remain to be considered, they are the constitution of the Trust, its finance, and its future. Again, in regard to development, these are inextricably mixed up. The leading idea of such a trust is government by those who use the facilities offered. I think we must turn again to Liverpool. Here the Dock Board consists of twenty-eight members, of whom twenty-four are elected by those who pay rates to the Board, and four are nominated members representing the Conservancy of the Mersey. The position now is that some of the elective members represent the shipowners, and other various associations of traders. In London, there might be other interests to be represented.

On account of the existence of the entrepot trade it would be probable that merchants and financiers rightly claim to have their voice heard. I believe, too, that the County Council and the Corporation ought also to have representatives on the Board, and I do so whilst feeling that many of those who are more qualified than myself to express an opinion differ entirely from me. We have before us an example of how not to do things in the case of Bristol ; there the Corporation acquired control of the docks many years ago, expenditure and development were kept down, and the port fell into a position scarcely better than that of London. Then the mercantile community of Bristol decided that something ought to be done. Various schemes were put forward and nothing could be done, owing, as it would appear, to the fact that control lay with those who were elected by a popular vote, and not on account of business considerations. Bristol has attained, and is now carrying out, a scheme of improvement. Sanction was obtained by the education of the great mass of the ratepayers by lectures and excursions to up-to-date ports. Such a crusade, difficult in a comparatively small place, would be hopelessly impossible in the metropolis. The expenditure of public money by the various municipal bodies in London on various schemes, more or less remotely connected with the accepted function of municipality, has gone perhaps too far, and the very greatest hesitation must be felt in proposing any additional charges to the rates. Nevertheless, it seems that money for the improvement of the port must be found or guaranteed by great public bodies. If the Corporation of the City of London and the London County Council were to guarantee the payment of the interest on the stock of the proposed Trust, the rate of interest payable by it would be materially lower than it would otherwise be. Moreover, there would be no difficulty in obtaining such further sums as may be immediately necessary for the proper development of the port. The keeping down of charges is essential to the retention of existing trade and to the attraction of new business. In no ordinary cases, do I think

charges should be allowed to be increased beyond present rates. Hence it seems essential that such guarantee be sought. The economy in management afforded by proper development and united management will give such a revenue as will meet the necessities of the case. It would be unfair to ask it — nor would the request be likely to meet with a favourable response—if no voice in the control were offered. Without suggesting that the position I have described in Bristol should be reached, it would be quite possible to allow members nominated by those two public bodies to represent them on the Trust. Probably, therefore, the number of members on the Board should be not less than forty.

As regards dock improvement, there are, of course, many schemes which may come to be considered, and which it is the peculiar province of engineers and experts to discuss. A large number of schemes have already been brought forward; amongst them I would like to mention that of Mr. Douglas Owen, who proposed the alteration of the docks so as to give special facilities for the barge traffic which has so characterised the port. There are proposals for jetties at Canvey Island, and for dockising the river from Gravesend. It may be premature to discuss this now. Whatever may be the scheme best suited to the wants of the community it will have to be carried out by a Trust.

There are at the moment opportunities for less ambitious improvement, such as the extension of the Albert Dock and even the dockization of the entrance to the River Lea. It is not, I think however, not yet time to go even into these.

Finally, I would like to remark that Liverpool does not pay the members of her Dock Trust. No ornamental members grace the Board. She nevertheless commands the faithful services of some of her best shipowners and business men without remuneration, and I should be sorry to suppose that public spirit in London is not equal to a similar demand.

APPENDIX.

The Growth of Steamers.

In the Appendices to the report of the Royal Commission, Mr. E. G. C. Scott states that there is no ship afloat which cannot enter Tilbury Dock, and only 28 that cannot enter the Royal Albert Dock.

He gives the following Tables, viz.:—

"During the past ten years the following steamers, over 7,000 tons gross, have been built":—

			Ft.
In United Kingdom...	90	Average length	490
In Foreign Countries.	30	Average length	522
	120		

"These 120 ships have included the following English ships over 600 feet in length and 65 feet beam":—

	Length.	Beam.	Tons.
Oceanic	685.7	68.3	17,274
Campania	601.0	65.2	12,950
Lucania	601.0	65.2	12,952
Minnehaha	600.7	65.2	13,401
Minneapolis	600.0	65.0	13,401

"And the following foreign ships over 600 feet in length and 65 feet beam":—

	Length.	Beam.	Tons.
Deutschland	662.7	67.0	15,500
Kaiser Wilhelm der Grosse ...	627.7	66.0	14,349

Thus he concludes there are only "seven out of the total number of 120 above referred to which are over 600 by 65, all the others could enter Tilbury Dock, and the *Minneapolis* and *Minnehaha* regularly use that dock."

"The Royal Albert Dock can take ships up to say 536 feet long; only 18 English and nine foreign ships out of the above 120 are over 536 feet in length."

On the above I need hardly criticise the treatment of the figures. When vessels of over 10,000 tons are beginning to abound and ships of twice that size exist, it seems misleading to take as low a limit as 7,000 tons and then average those above. A far more satisfactory result for those who state the case thus would be arrived at by taking the average length of all vessels afloat, including barges and fishing boats. But it would be absolutely useless for those who want to know the real position of the docks.

A second Table set out at pages 451 and 452 of the "Appendices" purports to give details of "the steamers of over 7,000 gross built since 1890 and afloat on the 30th January, 1900." This paper was handed in on the 9th November, 1900.

I consider the system on which this Table is arranged quite uninforming, and I have therefore re-arranged it and supplemented so as to include those vessels of over 7,000 tons, as I will take his own limits still, built prior to the date at which he commences; I also cover those of over 10,000 tons, built subsequently to 30th January, 1900, as far as I can note them. I have not had the advantage of official assistance and so cannot hope to be as exhaustive as he.

Table I.

Vessels marked [T] are twin screws.

Flags.—B, British; D, Danish; F, French; G, German; R, Russian.

Steamer.	Year.	Place of build.	Gross tonnage.	Dimensions. l'gth.	beam
1.*City of Rome ... B	1881	Barrow	8,415	**562.2**	52.3
2.*Servia .... B	1881	Glasgow	7,392	515.0	52.1
3.*Aurania .... B	1882	Glasgow	7,269	470.0	57.2
4.*Oregon .... B	1883	Glasgow	7,375	501.0	54.2
5.*Umbria .... B	1884	Glasgow	7,715	501.6	57.2
6.*Etruria .... B	1884	Glasgow	7,718	501.6	57.2
7.*La Champagne F	1885	St. Nazaire	7,087	492.1	51.5
8.*La Bourgogne ... F	1885	St. Nazaire	7,395	492.1	51.5
9.*La Gascogne...... F	1885	La Seyne	7,395	492.0	52.0
10.*La Bretagne ...... F	1886	St. Nazaire	7,112	495.4	51.8
11.*City of New York [T] B	1888	Glasgow	10,499	**527.6**	63.2
12.*City of Paris [T] B	1888	Glasgow	10,499	**527.6**	63.2
13.*Augusta Victoria [T] G	1888	Stettin	7,'61	459.3	55.7
14.*Teutonic...... [T] B	1889	Belfast	9,685	**565.8**	57.8
15.*Majestic...... [T] B	1889	Belfast	9,861	**565.8**	57.8
16.*Columbia ... [T] G	1889	Belfast	7,363	463.5	55.6
17.*Normannia [T] G	1890	Glasgow	8,242	500.2	57.5
18.*Furst Bismarck [T] G	1890	Stettin	8,874	562.6	57.6
19.*La Touraine [T] F	1890	St. Nazaire	8,863	520.2	56.3
20.*Spree .... [T] G	1890	Stettin	8,278	528.4	51.8
21. Scot .... [T] B	1891	Dumbarton	7,815	**531.0**	54.8
22. Gothic........ [T] B	1893	Belfast	7,755	490.7	53.2
23. Cevic .... [T] B	1893	Belfast	8,301	500.0	60.0
24.*Campania ... [T] B	1893	Glasgow	12,950	**601.0**	65.2
25.*Lucania ...... [T] B	1893	Glasgow	12,952	**601.0**	65.2
26. Caledonia ... [T] B	1894	Greenock	7,558	486.0	54.2
27. Kensington [T] B	1894	Glasgow	8,669	480.0	57.2
28. Southwark... [T] B	1894	Dumbarton	8,607	480.0	57.2
29. Norman ...... [T] B	1894	Belfast	7,537	490.8	53.2
30. Palatia ...... [T] G	1894	Stettin	7,979	461.1	52.8
31. Phoenicia [T] G	1894	Hamburg	7,412	461.2	52.3
32.*St. Louis [T] US	1895	Philadelphia	11,629	535.5	63.0
33.*St. Paul ... [T] US	1895	Philadelphia	11,629	535.5	63.0
34. Georgic ...... [T] B	1895	Belfast	10,077	**558.7**	60.3
35. American ... [T] B	1895	Belfast	8,196	475.9	55.2
36. Armenia .... B	1895	Belfast	8,825	512.5	59.2
37. Victorian .... B	1895	Belfast	8,825	512.5	59.3
38. Cestrian .... B	1896	Belfast	8,823	512.5	59.2
39. China .... B	1896	Belfast	7,912	500.5	54.2
40. European...... [T] B	1896	Belfast	8,194	475.9	55.2
41. Pennsylvania [T] G	1896	Belfast	13,265	**559.4**	62.2
42. Algoa .... B	1896	Sunderland	7,575	455.0	58.0
42 Barbarossa... [T] G	1896	Hamburg	10,796	526.4	60.0
44. Friedrich der Grosse [T] G	1896	Stettin	10,568	523.0	60.0
45. Königin Luise [T] G	1896	Stettin	10,566	523.4	60.3
46. Canada .... [T] B	1896	Belfast	8,806	500.4	58.2
47. Briton........ [T] B	1897	Belfast	10,248	**530.3**	60.3
48. Norseman ... [T] B	1897	Belfast	11,677	500.7	62.3
49. Delphic ...... [T] B	1897	Belfast	8,273	475.9	55.2
50. Egypt .... B	1897	Greenock	7,912	499.8	54.5
51. Milwaukee........ B	1897	Newc'stle	7,323	470.0	56.1
52. Montrose .... B	1897	Middlesboro'	7,094	444.3	52.0
53. Monarch .... B	1897	Newc'stle	904	470.0	56.0
54. Rotterdam [T] D	1897	Belfast	8,139	470.3	53.2
55. Bremen ... [T] G	1897	Dantzig	10,525	525.1	60.2
56. Kaiser Friederich [T] G	1897	Dantzig	12,480	**581.7**	63.7
57.*Kaiser Wilhelm der Grosse [T] G	1897	Stettin	14,349	**626.7**	66.0
58. Konig Albert [T] G	1897	Stettin	10,643	449.3	60.2
59. Pretoria...... [T] G	1897	Hamburg	13,190	**561.0**	62.3
60. Cymric ...... [T] B	1898	Belfast	12,647	**585.5**	64.3
61. New England [T] B	1898	Belfast	11,394	**550.3**	59.3
62. Afric .... [T] B	1898	Belfast	11,948	**550.2**	63.3
63. Medic .... [T] B	1898	Belfast	11,985	**550.2**	63.3
64. Arabia .... B	1898	Greenock	7,093	499.7	54.3
65. Carisbrook Castle B	1898	Glasgow	7,623	485.0	56.0
66. India .... B	1898	Greenock	7,911	499.7	54.3
67. Indore........ B	1898	Belfast	7,300	480.0	42.3
68. Irishman ... [T] B	1898	Belfast	8,001	490.5	56.0
69. Knight Errant ... B	1898	Glasgow	7,464	470.0	57.2
70. Manhattan... [T] B	1898	Belfast	8,004	490.5	56.3
71. Marquette .... B	1898	Glasgow	7,057	486.5	56.3
72. Mount Royal ... B	1898	Newc'stle	7,087	445.0	52.2
73. Pinemore .... B	1898	Glasgow	7,807	459.0	52.5
74. Quernmore ...... B	1898	Belfast	7,304	480.0	52.3
75. Rapidan .... B	1898	Hartlepool	7,505	475.5	56.0
76. Ultonia ...... [T] B	1898	Newc'stle	8,845	500.3	57.4
77. Statendam [T] D	1898	Belfast	10,491	515.3	59.8
78. Bengalia .... G	1898	Glasgow	7,671	485.0	57.0
79.‡Moskwa...... [T] R	1898	Glasgow	7,270	487.0	58.3
80. Batavia ...... [T] G	1898	Hamburg	10,175	501.3	62.2
81. Bulgaria ... [T] G	1898	Hamburg	10,237	501.4	62.2
82. Graf Waldersee G	1898	Hamburg	13,148	**561.2**	62.2
83. Bavarian...... [T] B	1899	Dumbarton	10,376	501.1	59.3
84.*Oceanic ...... [T] B	1899	Belfast	17,274	**685.7**	68.3
85. Persic .... [T] B	1899	Belfast	11,973	**550.2**	63.3
86. Saxon .... [T] B	1899	Belfast	12,570	**570.0**	64.0
87. Winifredian ..... B	1899	Belfast	10,405	**552.5**	59.3
88. Assaye ...... [T] B	1899	Greenock	7,376	450.0	54.2
89. Atlantian [T] B	1999	Newc'stle	9,355	482.0	57.3
90. British Prince [T] B	1899	Newc'stle	7,325	470.0	56.8
91. British Princess [T] B	1899	Newc'stle	7,460	470.0	56.8
92. Collegian .... B	1899	Glasgow	7,237	470.0	56.2
93. Kildonan Castle [T] B	1899	Glasgow	9,692	515.3	59.2
94. Kinfauns Castle [T] B	1899	Glasgow	9,652	515.3	59.2
95. Maplemore ...... B	1899	Glasgow	7,803	459.0	52.5
96. Michigan ... [T] B	1899	Belfast	9,510	500.7	62.4
97. Montezuma [T] B	1899	Glasgow	7,345	485.0	59.0
98. Montfort...... [T] B	1899	Newc'stle	7,087	445.0	52.2
99. Omrah ...... [T] B	1899	Barrow	8,291	490.7	56.7
100. Ortona ...... [T] B	1899	Barrow	7,945	500.0	55.3
101. Politician .... B	1899	Newc'stle	7,228	469.5	56.4

Steamer.	Year.	Place of build.	Gross tonnage.	Dimensions. l'gth.	beam
102. Star of Australia B	1899	Belfast	7,198	440.0	55.1
103. Bethania .... G	1899	Glasgow	7.492	485.0	57.4
104. Bosnia .... G	1899	Newc'stle	7,436	485.0	57.0
105. Drachenfels ...... G	1899	Newc'stle	7,144	456 0	53.1
106. Hannover [TS] G	1899	Newc'stle	7.305	430.0	54.3
107. Potsdam... [TS] D	1899	Hamburg	12,522	**549.9**	62.0
108. Belgravia... [T] G	1899	Hamburg	10,178	501.1	62.2
109. Grosser Kurfurst [T] G	1899	Stettin	12,500	**559.7**	62.0
110. Hamburg... [T] G	1899	Stettin	10,600	499.3	60.1
111. Main .... [T] G	1899	Hamburg	10,067	501.0	58.1
112. Patricia ... [T] G	1899	Stettin	13,424	**560.0**	62.3
113. Rhein ...... [T] G	1899	Hamburg	10,058	501.0	58.1
114. Frankfurt... [T] G	1899	Geestemunde	7,431	429.0	54 3
115. Koln .... [T] G	1899	Geestemunde	7,409	428.9	54.3
116. Devonian .... B	1900	Belfast	10,418	**552.5**	59.3
117. Ivernia ...... [T] B	1900	Newc'stle	14,058	**582.0**	64.9
118. Minneapolis [T] B	1900	Belfast	13,401	**600.7**	65.5
119. Minnehaha [T] B	1900	Belfast	13.403	**600.7**	65.5
120. Tunisian ... [T] B	1900	Glasgow	10,576	500.6	59.2
121. Vaderland [T] B	1900	Glasgow	11,899	**560.8**	60.2
122. Zeeland ... [T] B	1900	Glasgow	11,905	**561.6**	60.2
123. Achilles .... B	1900	Greenock	7,043	442.5	52.8
124. Agamemnon ... B	1900	Greenock	7,011	442.1	52.7
125. Ajax .... B	1900	Greenock	7,040	442.0	52.8
126. Custodian... [T] B	1900	Glasgow	9,214	482.0	57.2
127. Lake Erie .. [T] B	1900	Glasgow	7,550	446.0	52.0
128. Mechanician [T] B	1900	Belfast	9,044	482.0	57.3
129. Persia .... B	1900	Greenock	7,951	499.8	54.3
130. Tactician .... B	1900	Newc'stle	7,281	470.0	56.2
131. Sobraon ... [T] B	1900	Greenock	7,382	450.0	54.2
132. Belgia ...... [T] G	1900	Newc'stle	7,507	485 0	57.5
133.‡Smolensk... [T] R	1900	Newc'stle	7,270	486.0	58 2
134.*La Lorraine [T] F	1900	St. Nazaire	11,869	**563.1**	60.0
135.*La Savoie... [T] F	1900	St. Nazaire	11,200	**563.1**	60.0
136.*Deutschland [T] G	1900	Stettin	16,502	**662.7**	67.0
137. Kiautschou [T] G	1900	Stettin	10,911	522.5	60.1
138. Prinzess Irene * [T] G	1900	Stettin	10,881	523 5	60.2

§ Has overhanging bows.

1 and 2. Now broken up.

4 and 8. Lost by collision.

11 and 12. Now under United States flag as *New York* and *Philadelphia*.

17. Appears in Mr. Cater Scott's Table under her new name, *L'Acquitaine*.

20. *Spree* appears in Mr. Scott's Table as *Kaiserin Maria Theresa*. She passed the limit by lengthening.

21. Was originally of 6,844 tons, but has been brought by lengthening into Mr. Scott's Table.

42. Appears as *Barossa* in Mr. Scott's list.

38. Has been lengthened.

68. Ex *Michigan*; 71. Ex *Boadicea*.

131. Wrecked.

‡ Vessels marked thus are of the Russian Volunteer Fleet, and have a quasi military character.

General Notes.

The first 16 steamers were launched prior to the time at which Mr. Scott's table began. I do not think with regard to docking purposes the ship's depths, as shown in the Register, are of the smallest importance. They relate to classification. If we could have the designed draughts, which are not published, we should really be having something of value. But as we have only these I have eliminated them, and have stated instead the cases where twin screws are fitted, since the tips of the propeller blades, extending as they do, may affect the question of the width of dock entrances.

Vessels marked * are Atlantic mail steamers, which are unlikely under existing circumstances to trouble the Thames, save, perhaps, for dry docking purposes if facilities are available.

I have generally given the tonnages with which the ships were credited when they came out, though in certain cases some hundreds of tons have been added to the gross register by the provision of further deck erections.

The special type given to the length of certain vessels shows that these ships are admittedly too long for the Royal Albert Dock entrance. Three ships whose length is under the 536 feet spoken of by the dock authorities I have added because they have clipper bows. I also have great doubt as to whether it would be safe to take the *St. Louis* or *St. Paul* into the dock. But I have given the dock the benefit of that doubt.

Table II.

Since Mr. Scott's Table closes, the output of big steamers has become so great that I cannot adhere to the limits, and now ignore all under 10,000 tons.

Steamers of Over 10,000 Tons.

Ship.	Gross tonnage.	Year.	Place of build.	Dimensions. l'gth.	beam
1. Saxonia ...... [T] B	14,281	1900	Glasgow	**580.0**	64.2
2. Runic .... [T] B	12,482	1900	Belfast	**550.2**	63.3
3. Suevic......... [T] B	12,500	1900	Belfast	**550.2**	63.3
4. Commonwealth [T] B	12,097	1900	Belfast	**578.3**	59 3
5. Neckar ...... [T] G	11,200	1900	Geestemunde	497.8	58.0
6. Celtic ... . [T] B	20,904	1901	Belfast	**680.9**	75.3
7.*Kaiser Wilhelm II.	20,000	1901	Stettin	**678.0**	72.0
8.*Kron. P. Wilhelm [T] G	14,980	1901	Stettin	**637.3**	66.3
9. Minnetonka [T] B	13 398	1901	Belfast	**600.7**	65.5
10. Ryndam [T] Dutch	12,527	1901	Belfast	**550.3**	62 3
11. Moltke ...... [T] G	11,800	1900	Hamburg	525.0	62.0
12. Blucher ..... [T] G	12,320	1901	Hamburg	525.0	62.0
13. Athenic ...... [T] B	12,234	1901	Belfast	500.0	63.3
14. Hanoverian [T] B	11,960	1901	Newc'stle	**580.0**	60.3
15. Haverford ... [T] B	11,635	1901	Glasgow	531.0	59.2
16. Siberia ... [T] USA	11,300	1901	Newport News	**550.0**	63.0
17. Korea ... [T] USA	11,276	1901	Newport News	**551.7**	63.2
18. Cedric......... [T] B	21,000	1902	Belfast	**680.0**	75.0
19. Carpathia ... [T] B	12,900	1902	Newc'stle	**540.0**	64.2
20. Finnland [T] USA	12,760	1902	Philadelphia	**560.0**	60.2
21. Kroonland [T] USA	12,760	1902	Philadelphia	**560.0**	60.2
22. Merion ...... [T] B	11,621	1902	Glasgow	530.0	59.2
23. Walmer Castle [T] B	12,546	1902	Belfast	**570.6**	64.4
24. Noordam ... [T] D	12,317	1902	Belfast	**550.3**	62.3
25. Ionic .... [T] B	12,234	1902	Belfast	500.0	63.3
26. Corinthic ... [T] B	12,234	1902	Belfast	500.0	63.3
27. Hellig Olaff [T] D	10,100	1902	Glasgow	500.0	58.3
28. Arabic......... [T] B	15,860	1903	Belfast	**600.7**	65.5
29. A larger Celtic [T] B	...	Bldg.	Belfast	**708.0**	75.0

DISCUSSION.

The Hon. SYDNEY HOLLAND (Deputy Chairman of the London and India Docks Company) said the author stated that he had no special qualifications for discussing this question, and that what he said must be general and sketchy. He always found that gentlemen who criticised the docks had the same qualifications. One remark which showed that, and which was characteristic of the whole address, was the statement that Bristol was almost as bad as the Port of London. That showed such ignorance as to clinch the statement that he had no qualifications for the task he set himself. The ratepayers of Bristol at present had to pay £28,000 a year towards the expenses of their port and that amount would be largely increased when their Avonmouth Dock was built. Did gentlemen present wish the Port of London to be run to the advantage of merchants and shipowners, at the expense of the ratepayers? It was monstrous that ratepayers should have to pay the expenses, so that the merchants and shipowners could get their goods into London at a cheaper rate. The author said that the docks in London had stood still, but he wished to contradict that statement. The docks of London were in advance, not only of every port in England, but of every port abroad. Every ounce of goods which went into the Liverpool dock, paid dues to the Dock Trust, to which the Dock Trust gave nothing at all. There were no charges like that in London, though the London Dock Companies had asked for them, and the Royal Commission had reported in their favour. London had increased in the matter of docks vastly more than Liverpool. Figures had been published recently in reply to an article in the *Financial News*, showing that the tonnage was greater and the shipment of goods greater, and that the increase was more than at Liverpool. The Dock Companies had nothing to do with the dredging of the river, though it would be much to its advantage to get a deep river. He was in favour of the election of a Trust to look after the river dredging, its lighting, its buoying, and managing the policy of the river, but he was against a Trust for managing the commercial side of the business. The author said they should have a Trust, and let the docks their warehouses; but that was contrary to the whole policy of Parliament, that there should be a Trust set up with the rates of London behind it to compete with private enterprise; and it would be obviously unfair on the present wharfingers. If the rates were not put behind the Trust, it would be necessary to buy out the Dock Companies with cash, and not to exchange their securities for the Trust securities. That meant the public would have to pay something like twenty-five to thirty millions of money, which was practically impossible. Did he understand Dr. Ginsburg to suggest that the Dock Companies might not sell their land and property for what it was worth to-day? In that declaration the author probably stood alone. He (Mr. Holland) was a Parliamentary lawyer, and had never yet heard a man say that something worth a million pounds must be sold for £100,000 because it was not being used in a way to fetch its full value. Undoubtedly, if the Dock Companies sold its undertakings to the country, the country must pay the arbitration value of it at the present day, not what it stood at in the company's books, nor the price being earned at the moment. If a new Trust was to own docks and sell the warehouses, that would mean a loss to the new Trust of something like four hundred thousand pounds a year. All the warehouse servants of the company were under an agreement with regard to pensions, and the transfer would mean the payment on that account of £100,000 a year. Moreover, if it were managed by an elected Trust composed of merchants and shipowners, it would be to the interest of those merchants and shipowners to get their charges as cheaply as possible. Therefore, if the rates were behind them, the charges would be as low as possible, and the ratepayers would have to pay as much as possible.

Mr. T. V. S. ANGIER said his impression of Dr. Ginsburg's paper was very different from that expressed by Mr. Sydney Holland. He (Mr. Angier) had learned his lesson in the daily use of the various docks and wharves, and he could appreciate how well-informed the author was. He had little complaint to make against the docks. There were certain craft which they did not suit; but it rested with the Dock Companies to consider whether it was to their interest to suit their accommodation to the alterations in craft or not. He saw no use in interfering with the Dock Companies, which, no doubt, had their own troubles, one of them being that they were over-capitalised. But the Companies must be sold up some day, as concerns in that condition generally were. The great point was the state of the approaches to the river. There should be at least a 35 ft. draught at all tides. The shores at present were totally neglected, and sufficient advantage was not taken of quaying possibilities. Craft did not want to waste a day in docking, but wished to get away as quickly as possible. The dock companies should be allowed to have free and open competition. The position of London could not be compared with that of Liverpool. With regard to creating a monstrous Trust at arbitration prices, that would be too gigantic a tax upon the trade of London and would result in doubling the charges. The Thames Conservancy, which had proved it was not adapted to its work, could be reformed by altering its composition; it should have on its Board expert men, and should have power to raise funds. The result would be that the docks and wharves would have to square themselves with the competition of the improved quaying of the river, and there would be cheapening of the port, instead of creating a vast and almost irresponsible Trust.

Mr. W. H. Lawson deplored the feature that ever since the inquiry into the port was commenced more strong language had been forthcoming than strong facts, and that language went a little too far in the mouth of Mr. Sydney Holland that evening. Probably that gentleman did not mean exactly what he said. He (Mr. Lawson) thought the conclusion arrived at by the Royal Commission was the most illogical from the facts given in their report; the facts were well-stated, but he did not think a weaker use could have been made of them. The County Council and the London Chamber of Commerce entirely differed from the dock directors as to the value of their property, but for the opposite reason, viz., they thought the property so worthless, as it stood, that they seemed anxious to secure it at any possible price. Thus the County Council and the Chamber of Commerce were found hand in hand, pushing the most gigantic scheme that any ratepayers had been threatened with. Royal Commissions generally ended by recommending that somebody should be bought out. There had been twenty inquiries on the Thames and half a dozen Royal Commissions, and the only conclusions arrived at, were that somebody should be bought out. As for the lighters, he thought there was more reason to buy them out and burn them than anything else. Accommodation was wanted for the class of ship built in the last ten or twelve years, and ample room could be found for that class on the Thames without touching a single dock or wharf. The Dock Company did not want to develop Tilbury Dock, because that would then be a rival to the Port of London. A dock for very large steamers should be built, and its design should be settled by a commission of engineers, railway men, and shipowners, and then tenders should be publicly invited for the building of it. It would be unfair for any Trust to compete in the matter, because no one had a monoply of the river.

Mr. R. N. Tough said when Mr. Lawson suggested the burning of the barges he could have had no idea of the number of barges in use, and their value, viz., $2\frac{1}{2}$ million pounds. He reminded the audience of the statement in the paper that 60 per cent. of the imports and 90 per cent. of the exports were transferred by barges. The chief cause of that was the heavy charges made by the dock companies when they had to handle those goods, charges higher than at any other European port. He (Mr. Tough) had had goods consigned to him from a port in the interior of America, and the charge from there to Boston, and the freight to the docks, had been less than the London Dock Company charged him for the lifting of the goods to the quay from the steamer. He thought the dock companies should go on as at present, as competitors, but they should be satisfied with the legislation they already possessed. The whole agitation arose through the dock companies going to Parliament to father their cause and to give them authority to levy charges to which they were not entitled.

Mr. Douglas Owen, speaking as a student of the subject rather than as a practical man, thought that the docks had been very hardly used in the controversy. Complaint had been made of the high charges; but how could it be otherwise when it was admitted that 76 per cent. of the goods coming into the docks never paid a penny towards those docks? There was great cause for complaint in the congestion of the quays, and the obstruction of the docks by barges. He objected to the dock companies being abused.

Captain Anthony S. Thomson said the author had made one or two startling statements. According to him, the docks were valuable land, but nothing more, and the chief complaint was that they would not take more than 700 feet ships. The docks were never intended to take in ships of that size, and it would be many years before they would be required to. The few large ships which came to London were not these for which it was necessary to legislate, but for those of moderate size. Enterprising shipowners had built very large ships, and it remained to be seen whether they would pay in the long run. There was an idea that everything which tended towards cheapness and economy was good, and for the benefit of the port, but it was not necessarily so.

Mr. C. J. Cater Scott (Chairman of the London and India Docks Company) thought it was unnecessary for the author to have said he was not an expert, as it was easy to find that out, and he questioned whether he had ever seen any of the docks in London. Probably Dr. Ginsburg, like many other people, had derived his experience from reading a number of statements, some well-founded, but others the reverse. Any ship which could go through the Suez Canal, could go into the Albert Dock, and dock there. The Peninsular and Oriental Company and others were finding a necessity to build their ships larger. The Dock Company saw that necessity coming, and got authority from Parliament, over two years ago, to build new docks alongside the Albert Docks, and it was only due to the report of the Royal Commission, which paralysed everything, that its construction had not been begun before now. He defied anyone to point to a single ship in the world which could not be docked at Tilbury Dock, and at least as well as at Liverpool. It cost no more to bring goods by water from Tilbury than from the Albert Dock. In opposition to the statement that the charges on shipping were enormous, he quoted the case of the *Politician*, which was put before the Commission. At first it appeared as if Liverpool was cheaper than London, but when the matter was referred to his company, to know if the statements were true, it was pointed out that only part of the story had been told, viz., what the shipowners paid, not what the consignees paid. The total charges in Liverpool were found to be considerably in excess of those in London. The Port of London had been

developed at the expense of his company, and long before the trade really wanted it, as witness the Tilbury Docks, costing three millions. The company went to Parliament, because it could not ask its shareholders to go on paying for the alterations, when there was no dividends. Liverpool had the right of levying charges on everything coming into the port, totalling £600,000 per annum, but not so London. He thought it against the interests of the Port of London that the control of the company should pass into the hands of any semi-political party.

Dr. GINSBURG, in reply, said that what he had seen or had not seen was of no importance to anybody but himself; but he had seen real docks as well as those of London. He had not said that the Millwall Docks were the principal docks in London. He had distinctly said that "Coming to the lower docks we find them the most important under the existing system." In reply to the challenge which had been thrown out that he could not mention a ship which could go through the Suez Canal and could not be docked in the Albert Dock, he instanced the case of the *Grosser Kurfurst.* This vessel had been through the Suez Canal, and, according to the limits mentioned in Mr. Scott's own statement before the Royal Commission, she could not enter the Albert Dock. Every one had the right to discuss the facilities given, since every consumer had an interest n dock management; and to criticise, because, as the dock companies held their property under various Acts of Parliament, they were, to a certain extent, in a fiduciary position. When the docks came to be bought, it would be remembered that, instead of the dock companies putting by a reserve fund, and attempting to improve their facilities, they waged war with one another. He did not see why the public should have to pay for the money which had been wasted in idle fighting.

The CHAIRMAN said that he personally did not agree with every word in the paper, but that was no reason why he should use discourteous language to the author. Mr. Sydney Holland, in his opening remarks, had rather exceeded the limits of reasonable controversy. He proposed a hearty vote of thanks to the author, which was carried unanimously, and suitably acknowledged by Dr. Ginsburg.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock :—

FEBRUARY 18.—"Three-Colour Printing." By HARVEY DALZIEL. CARMICHAEL THOMAS will preside.

FEBRUARY 25.—"Tonkin, Yunnan and Burma." By FRED. W. CAREY, late H.B.M.'s Acting-Consul at Szemao, China.

Dates to be hereafter announced :—

"Existing Laws, By-laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions." By T. BRICE PHILLIPS. (Fothergill Prize Essay.)

"Oil Lighting by Incandescence." By ARTHUR KITSON.

"The Use of Electrical Energy in Workshops and Factories." By ALFRED C. EBORALL, M.I.E.E.

"Modern Bee-Keeping." By WALTER FRANCIS REID, F.C.S.

"Education in Holland." By J. C. MEDD.

"Preservation of the Species of Big Game in Africa." By E. NORTH BUXTON.

"Fencing as an Art and an Historic Sport." By EGERTON CASTLE, M.A.

"The River Thames and the Desecration of the Picturesque." By J. ASHBY STERRY.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

FEBRUARY 26. — "Gleanings from the Indian Census." By JERVOISE ATHELSTANE BAINES, C.S.I.

MARCH 12.—"The Currency Policy of India." By J. BARR ROBERTSON. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

APRIL 23. — "The Province of Sind." By HERBERT MILLS BIRDWOOD, C.S.I., M.A., LL.D.

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 or 5 o'clock :—

MARCH 3, at 4.30 p.m.—"The Uganda of To-day." By HERBERT SAMUEL, M.P. Sir HARRY H. JOHNSTON, G.C.M.G., K.C.B., will preside.

MARCH 31, at 4.30 p.m.—"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo.

MAY 5, at 4.30 p m.—"The Lagos Hinterland: its People and its Products." By MAJOR J. H. EWART.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock.

FEBRUARY 17. 8 p.m.—"Heraldry in Decoration." By GEORGE W. EVE, A.R.E. LEWIS FOREMAN DAY will preside.

MARCH 17. 4.30 p.m.—"Artistic Fans." By MISS HANNAH FALCKE. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

Messrs. James Powell and Sons have kindly invited the Applied Art Section to visit the Whitefriars Glass Works, Tudor-street, E.C., on Tuesday evening, April 28th, from 7.30 to 10.30 p.m. A short paper on "Modern Table Glass" will be read by Mr. Harry Powell, and the processes of glass blowing will be explained in the glass house. The number of visitors will be limited to 100. Further particulars will be announced later on.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

JULIUS HÜBNER, "Paper Manufacture." Four Lectures.

LECTURE III.—FEBRUARY 16.— Stuff-chest—Regulator — Sand-tables — Strainer — Hand-made paper—Fourdrinier paper machine.

LECTURE IV.—FEBRUARY 23.—Single cylinder and other types of paper-making machines—Finishing — Cutting—Statistics—Paper-testing—Experimental paper making.

PROF. J. A. FLEMING, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." Four Lectures.
March 2, 9, 16, 23.

W. WORBY BEAUMONT, Mem.Inst.C.E., "Mechanical Road Carriages." Four Lectures.
April 27, May 4, 11, 18.

MEETING FOR THE ENSUING WEEK.

MONDAY, FEB. 16...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Julius Hübner, "Paper Manufacture." (Lecture III.)
Optical Society, 20, Hanover-square, W., 8 p.m Annual Meeting.
British Architects, 9, Conduit-street, W., 8 p.m. Mr. B. Champneys, "College Planning."
Medical, 11, Chandos-street, W., 8½ p.m.
Asiatic, 22, Albemarle-street, W. 3 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Professor Edward Hull, "The Cheesewring, Cornwall, and its Teachings."
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Roger E. Fry, "The Art of Piero di Cosino."

TUESDAY, FEB. 17...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. George W. Eve, "Heraldry in Decoration."
Royal Institution, Albemarle-street, W., 5 p.m. Prof. Allan Macfadyen, "The Physiology of Digestion." (Lecture VI.)
Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. David Carnegie's paper, "The Manufacture and Efficiency of Armour-Piercing Projectiles." 2. Mr. George Frederick Zimmer, "Mechanical Handling of Material."
Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. J A. Baines, "A Census of the Empire."
Pathological, 20, Hanover-square, W., 8½ p.m.
Photographic, 66, Russell-square, W.C., 8 p.m.
Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. F. Pickard-Cambridge, "Some new Species of Spiders belonging to the Families *Pisauridæ* and *Senoculidæ*." 2. Mr. Cyril Crossland, "The Marine Fauna of Zanzibar and British East Africa, from Collections made by the Author in 1901-02." 3. Mr. G. Candler, "The Habits of the Hoolock."
Art Workers' Guild and Society of Designers, Clifford's-inn, Fleet-street, E.C., 8 p.m. Mr. F. Hamilton Jackson, "Intarsia and Marquetry: the history, principles, and practice of the Art."

WEDNESDAY, FEB. 18...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Harvey Dalziel, "Three-Colour Printing."
Meteorological, 70, Victoria-street, S.W., 7½ p.m. Mr. Edward Mawley, "Report on the Phenological Observations for 1902."
Microscopical, 20, Hanover-square, W., 8 p.m. Demonstration by Dr. Arthur W. Rowe on "The photomicrography of opaque objects as applied to the dilineation of the minute structure of chalk fossils."
Chemical, Burlington-house, W., 5½ p.m. 1. Mr. G. D. Lander, "The Molecular re-arrangement of N-substituted Imino-ethers." 2. Mr. G. D. Lander, "The Nature and probable Mechanism of Metal Replacement in Tautomeric Compounds." 3. Messrs. W. J. Sell and F. W. Dootson, "The Chlorine Derivatives of Pyridine." (Part VIII. The Interaction of 2 : 3 : 4 : 5 — tetrachlorpyridine with Ethyl Sodiomalonate." 4. Messrs. A. McKenzie and A. Harden, "The Biological Method for resolving inactive Acids into their optically active Components."
Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, FEB. 19....Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. Prof. J. C. Bose, "Electric pulsation in *Desmodium gyrans*." 2. Miss Alice L. Emberton, "*Cerataphis Lataniæ*, a remarkable Aphid." 3. Mr. S. E. Salmon, "Specialisation of Parasitism in the Erysiphaceæ."
Society for the Encouragement of Fine Arts, 6½, Suffolk-street, Pall-mall, S.W., 8 p.m. Mrs. Ray Lincham, "The Spirit of Ancient Egypt."
Royal Institution, Albemarle-street, W., 5 p.m. Sir Clements Markham, "Arctic and Antarctic Exploration." (Lecture III.)
Historical, Clifford's-inn-hall, Fleet-st., E.C., 5 p.m. Annual Meeting.
Numismatic, 22, Albemarle-street, W., 7 p.m.
Mining and Metallurgy, at the Rooms of the Geological Society, Burlington-house, W., 8 p.m. 1. Mr. G. Percy Ashmore, "An improved form of Mining Windlass." 2. Mr. S. J. Speak, "Mining in Korea."

FRIDAY, FEB. 20...Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Mr. J. D. Batten, "Dante's Illustrators."
Royal Institution, Albemarle - street, W., 8 p.m. Weekly Meeting. 9 p.m. Principal E. H. Griffiths, "The Measurement of Energy."
Mechanical Engineers, Storey's-gate, Westminster, S.W.. 8 p.m. 1. Annual General Meeting. 2. Discussion on papers by Professor John Goodman, "Hydraulic Experiments on a Plunger Pump;" and by Mr. Thomas E. Stanton, "Experiments on the Efficiency of Centrifugal Pumps."
Geological, Burlington-house, W., 3 p.m. Annual Meeting.
Queckett Microscopical Club, 20, Hanover-square, W.C., 8 p.m. Annual Meeting.

SATURDAY, FEB. 21...North East Coast Institute of Engineers and Shipbuilders, West Hartlepool, 7½ p.m.
Royal Institution, Albemarle - street, W., 3 p.m. Mr. A. B. Walkley, "Dramatic Criticism." (Lecture III.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

MONDAY, FEBRUARY 23, 8 p.m. (Cantor Lectures.) JULIUS HÜBNER, "Paper Manufacture." (Lecture IV.)

WEDNESDAY, FEBRUARY 25, 8 p.m. (Ordinary Meeting.) FRED. W. CAREY, "Tonkin, Yunnan, and Burma."

THURSDAY, FEBRUARY 26, 4.30 p.m. (Indian Section.) JERVOISE ATHELSTANE BAINES, C.S.I., "Gleanings from the Indian Census."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

Mr. JULIUS HÜBNER delivered the third lecture of his course on "Paper Manufacture" on Monday evening, 16th inst.

The Lectures will be printed in the *Journal* during the summer recess.

APPLIED ART SECTION.

On Tuesday evening, February 17, 1903, LEWIS FOREMAN DAY, Vice-President of the Society, in the chair. The paper read was "Heraldry in Decoration." By GEORGE W. EVE, A.R.E.

The paper and report of the discussion will be published in the next number of the *Journal.*

SUPPLEMENT TO JOURNAL.

With this number of the *Journal* is issued a coloured supplement illustrative of Mr. Harvey Dalziel's paper on "Three-Colour Printing."

Proceedings of the Society.

COLONIAL SECTION.

Tuesday, February 10, 1903; the RIGHT HON. LEONARD H. COURTNEY, M.A., LL.D., in the chair.

The CHAIRMAN, in introducing Lady Aberdeen, said her work was well known to all who were interested in Canada, and was equally well known to all who were interested in public affairs in Great Britain and Ireland. For some time, Lord Aberdeen occupied the most important post of Governor-General, and during the time he was in Canada, Lady Aberdeen was associated with him in all the domain of affairs which was permissible to the representative of the Crown in a self-governed colony, *i.e.*, he observed all the traditions of respect due to the ministers of the Crown, acting on their advice in public matters, but he was also deeply interested in those social and economic questions which might be pursued with so much advantage to the community, even by a constitutional ruler. In all his work, Lady Aberdeen was most closely associated with him, and was, indeed, his second self; in fact, he thought he might say that in leaving the Dominion, she had not left it wholly unregarded; much of her heart was still there, and she had material as well as moral interests in the prosperity of the Dominion.

The paper read was—

WOMEN IN CANADA.

By THE COUNTESS OF ABERDEEN.

The title of my paper is infinitely suggestive.

There are few countries indeed whose past history and whose present development is so closely identified with the influence of its women.

The first European invaders of the continent found a Council of Women established as part of the fixed institutions of the fierce North American Indians of the Six Nations, a Council whose voice practically decided the succession to chieftancy, and whose titled women had not only the right of speaking in the Great Council of their nation, but were accustomed to have their opinions treated with deference when thus put before the headsmen.

And the early days of the history of Canada, after it was settled by white races, are illumined in all its provinces by the cherished

traditions of the high courage and devotion of heroic women, traditions which have remained the inspiration of descendants worthy of themselves.

Pathetically beautiful are the stories of the early French settlements in Canada, planted as they were by religious enthusiasm and missionary zeal; and it always seems to me that the remembrance of that little band of pioneer women who founded the great religious and educational and charitable institutions of Quebec and Montreal, has been an abiding benediction in the hearts of all French Canadians. Who, for instance, can ever visit the beautiful and proud city of Montreal without picturing the scene of its foundation, by the young noble Sieur de Maisonneuve, Mlle. Jeanne Mance, Mme. de la Peltrie and others, who had vowed to plant this mission in the wilderness. It is vividly described for us by the American historian Parkman:—

"In many of its aspects this enterprise of Montreal belonged to the time of the first Crusades. The spirit of Godfrey de Bouillon lived again in Chomedy de Maisonneuve; and in Marguerite Bourgeoys was realised that fair ideal of Christian womanhood, a flower of Earth expanding in the rays of Heaven, which soothed with gentle influence the wilderness of a barbarous age.

"On the 17th of May, 1642, Maisonneuve's little flotilla—a pinnace, a flat-bottomed craft moved by sails, and two row boats—approached Montreal; and all on board raised in unison a hymn of praise. Montmagny was with them, to deliver the island, in behalf of the Company of the Hundred Associates, to Maisonneuve, representative of the Associates of Montreal. And here, too, was Father Vimont, Superior of the missions, for the Jesuits had been prudently invited to accept the spiritual charge of the young colony. On the following day they glided along the green and solitary shores now thronged with the life of a busy city, and landed on the spot which Champlain, thirty-one years before, had chosen as the fit site of a settlement. It was a tongue or triangle of land, formed by the junction of a rivulet with the St. Lawrence, and known afterwards as Point Callière. The rivulet was bordered by a meadow, and beyond rose the forest with its vanguard of scattered trees. Early spring flowers were blooming in the young grass, and birds of varied plumage flitted among the boughs.

"Maisonneuve sprang ashore and fell on his knees. His followers imitated his example, and all joined their voices in enthusiastic songs of thanksgiving. Tents, baggage, arms, and stores were landed. An altar was raised on a pleasant spot near at hand, and Mademoiselle Mance, with Madame de la Peltrie, aided by her servant, Charlotte Barré, decorated it with a taste which was the admiration of the beholders. Now all the company gathered before the shrine. Here stood Vimont in the rich vestments of his office. Here were the two ladies with their servant; Montmagny, no very willing spectator; and Maisonneuve, a warlike figure, erect and tall, his men clustering around him—soldiers, sailors, artisans, and labourers—all alike soldiers at need. They kneeled in reverent silence, and when the rite was over the priest turned and addressed them:—'You are a grain of mustard-seed, that shall rise and grow till its branches overshadow the earth. You are few but your work is the work of God. His smile is on you, and your children shall fill the land.'

"The afternoon waned, the sun sank behind the western forest, and twilight came on. Fireflies were twinkling over the darkened meadow. They caught them, tied them with threads into shining festoons, and hung them before the altar, where the Host remained exposed. Then they pitched their tents, lighted their bivouac fires, stationed their guards, and lay down to rest. Such was the birthnight of Montreal.

"Is this true history, or a romance of Christian chivalry? It is both."

We read the stories of the hardships and dangers endured by those earliest settlers in Canada, as if they were fairy tales; but they are fairy tales which handed down to generation after generation of children at their mother's knees, make for a high ideal of personal and patriotic duty. Such, for instance, is the story of the fourteen year old Madeleine de Verchères, who, with her little brothers of ten and twelve, and two soldiers, defended the fort of Verchères against the Iroquois for a week; or, the Lady de la Tour's defence of her husband's castle in Acadia against his enemies in his absence. Or again, in later days, in the war of 1812, we have Laura Secord, the wife of a militiaman, hearing accidentally of a secret plan of attack on a Canadian camp, and travelling alone through a wild country for twenty miles on foot in time of war and with Indians lurking all round, to warn the commander, thus not only saving the lives of our soldiers, but enabling them to secure a brilliant and valuable victory.

But the mention of Laura Secord reminds us of another band of heroic women who sacrificed their all for their country, in the days of the American Revolution, and whose descendants still cherish with pride the title of United Empire Loyalists. It is estimated that some forty to fifty thousand persons left their comfortable homes in the American colonies rather than relinquish their allegiance to the flag of Britain. They sought a refuge in the then wilds of Canada and scattered over the Mari-

time Provinces and the Eastern Townships, and Ontario, where many and many an honoured family now treasures records of the desperate straits to which their ancestors were put when they first began making a clearing in the forest and erected their log-houses. These records tell us of shifts for food; how many subsisted on beech-nuts and butter-nuts, or on boiled weeds, of the various devices to capture wild birds and game of various descriptions at a time when ammunition could not be afforded; how in one settlement a beef-bone was passed from house to house so that each family might boil it a little and get a flavour of it in their bran soup; how clothes were a sore problem, and how many resorted to the skins of animals after the fashion of our first parents; and it needs but little imagination to fancy how heavily these hardships and privations must have told on delicately nurtured women.

But they came through it all, and it is because of them and of others like-minded with them, that Canada is the country we are all so proud of to-day.

For the women settlers in the outlying parts of Canada and more recently in those wonderful Western Provinces of the Great Dominion, they too have counted, and are counting, for much in the building up of the new country whether as wives of farmers or ranchmen, or lumbermen, or Hudson Bay Company hunters, or miners. Women under such circumstances have the making of the country in their hands. The men are fully occupied in their task of conquering nature, and it remains for the women, not only to carry on the domestic work of the household without any of the conveniences of civilisation, but it is their part to create the atmosphere of home, and to set the standard of life, both for their own family and for the lone settlers who may be within calling distance.

There cannot be too much said about the beauties, the attractions, and the rich promise of life in Canada; but its present position, as I have said before, has been won by the unremitting toil of its pioneer settlers, and none have borne a heavier share of that toil than the young mothers, who, well educated themselves and brought up in comfortable homes, have afterwards passed through all the vicissitudes of rearing young families far away on the great lone prairies, or in the depths of the forests and mountains.

I have had opportunities of coming into contact with typical women of this description, and of realising their lives in different ways; in our own ranch life in British Columbia, where we are glad to think we still have a home, and when travelling with Lord Aberdeen in some of these outlying parts, especially when engaged in the effort to start the work of the Victorian District Nurses, as a memorial of our late Queen, it is then that some of these women makers of Canada have come to me, or have written to me, telling me of what they had passed through from the lack of doctors and nurses, or of help of any kind; and then again, I know a little more of such homes from the correspondence which I have been privileged to see from time to time, in connection with an Association through which those living in the more populous centres link themselves with these lonely homes, by collecting and sending them month by month parcels of good current literature, and maintain a personal correspondence with them.

Listen to a few extracts from the recipients of these little parcels:—

"I must thank you very much for your mindfulness of our family in sending us such nice parcels. The children dance with joy, and won't go to sleep the night your parcel comes."

"It is with great pleasure I received your letter. It is very lonely here all the long winter through. Since Christmas no one has been here except my sister and her husband, and three dear little children twice, so you will think it is no wonder we prize the books. I am sure if everyone that gets a parcel feels as happy as I do when they get it they must have a very happy day. The books you send are so nice I could not wish for any nicer. Thank you very much."

"I wish to thank you for the parcels of reading matter: this is the first letter I have written for many months, but wish you to know how much we appreciate the reading and your goodness in sending it. We have twice been visited by a clergyman this last winter who read and prayed with us, but no service has been held since last summer, and that was nine miles from here. We went and heard the canticles sung for the first time in eighteen years."

"We live in a very isolated part of the country, and are often weeks without seeing a neighbour."

"Send me something to help me teach the children. We are ten miles from a school, and they cannot attend it in such winters as we endure."

"All of us enjoy the reading, and the little ones the picture books, and you do send us beauties. I think if the people who give you the books to send were to see the pleasure they gave to us, they would, in a measure, feel repaid, for I do not have anything to spend on pleasure or anything but what is actually necessary. So you see the books are a great treasure, they are as gifts from friends, though I do not know those who sent them."

"Thank you so much for your kind Christmas letter and good wishes, it was such a pleasant surprise to hear from you, and we are also glad to know to whom to write to thank for the delightful parcels of literature we receive. Please thank the Association very, very sincerely on our behalf; we wish it could know how much its kindness in sending them to us is appreciated. We are sending them on to a poor family living in an isolated district eight miles from here, to whom they give the greatest pleasure."

"I receive the parcels sent by the Aberdeen Association, and I do like them. I can assure you there is no loneliness in this house when we receive them; they are very much appreciated here."

How I wish I could bring before you to-day some of those women I am thinking of, that they might tell you their life's story in their own simple manner, never thinking that they had been doing anything out of the way. For the most part they live and die unknown to fame, but you will agree with me that there are no class of citizens who deserve better of their country.

We honour and applaud our brave soldiers who respond nobly to the call of duty, and who lay down their lives for their country. But the men and women of Canada of whom I have spoken (and what I have said applies to every province alike), they have all silently, but surely, been also pouring out their lives in building us an Empire in that Golden West as the result of the toil of their hands and brains—and not only so, by their high character, their endurance, their sobriety, their determination at any cost to provide education for their children, they have created this people, which their eloquent and loved Premier acclaims with pardonable pride as "a nation."

In according the appreciation which we, in the old country, all feel for Canada in these days, let us look back a bit and remember to give honour to whom honour is due, as we think of the mothers of Canada who have, in very deed, given themselves for her.

But you will say, what of the result; what of the women in Canada of to-day? It was only when I began to prepare this paper, that I felt how rash I had been to attempt to paint the life and work of Canadian women in one brief hour.

Perhaps I can best sum up the chief impression made upon me by very close intercourse and friendship with them for several years, official and unofficial, by one word which is much in our mouths to day—efficiency. French, Canadian or Manitoban, Nova Scotian, British Columbian, or the women of Ontario, they are all alike hall-marked by this stamp.

Meet them in society, watch them at their sports, examine their philanthropic or missionary work, or observe into the ways of their households, and you will find as a general rule, capacity, alertness everywhere. Let me give you a simple illustration. On one occasion when the Governor-General and I were travelling across Canada, we were to dine one night at a house remarkable even amongst Canadian homes for its charm and beauty, presided over, as it is, by one of the most attractive of mistresses. We arrived and met with the warm welcome we knew awaited us. A *recherché* repast was laid out before us, and we were waited on by so trim a parlourmaid, so deft in her movements, so irreproachable in her cap and apron, that Lord Aberdeen felt constrained to compliment our hostess on the results of her training. "Oh," said the lady, "I am so glad you think Jane did well—I should like you to tell her so presently." And when that "presently" came, what should we discover but "Jane" arrayed in evening dress, and proving to be the daughter of the house, who in consequence of the unexpected departure of the servant, had had not only to wait at table, but to cook the meal with the assistance of her mother, an adept in such matters.

This is a perfectly fair illustration of how Canadian women seem able to combine the domestic duties of the household, whilst, at the same time, dressing charmingly, taking their place in society, participating in out-door sports, and directing philanthrophic work with great effectiveness.

From the scarcity of domestic servants they must perforce often attend very closely to the work of the household, but somehow they do not allow it to engross them to the exclusion of other interests.

Another instance occurs to me where a lady who with her daughter used to do all the work of her farm house, prepare the meals for the farm hands, and who was renowned for her dairy, yet at the same time was the active President of the Committee of the Local Hospital, and the very able President of the Women's Local Council of the same place.

The mention of this latter organisation reminds me that I cannot bring this paper to a conclusion without endeavouring to tell you something of this federation of women's societies and institutions in Canada, which has in a very marked manner brought out the inherent capacity of Canadian women in all departments of life.

When we arrived officially in Canada in

September, 1893, we found arrangements on foot for forming a National Council of Women in affiliation with the International Council of Women. Roughly speaking, this National Council is formed of some twenty-five Local Councils of Women, which now exist in all the chief centres of Canada, together with some nationally organised societies. The Local Councils, in their turn, seek to federate all societies and institutions which concern themselves with women and children, whether secular or religious, literary, artistic, athletic, social, or anything else. The various societies may wholly differ in aim, and they belong to every church and every section of the community. The one bond that unites them is an acknowledgment of the desire to act in accordance with the golden rule, and to be willing to work together for the common welfare of the community when occasion demands it.

This organisation has been the means of bringing together the women workers of the different provinces in a way wholly new, for each province being governed by different internal laws, the tendency before, both on account of this, and because of the magnificent distances, was to act apart from one another.

The women have shown great ability in the preparation of the papers read at the annual conferences, and the ten volumes containing a report of these conferences and reports of the work done are in themselves a testimony to the value of that work.

I dare not even attempt a sketch of what has been accomplished, but I may give a few illustrations of the result of this co-operation, and I would like to say in carrying out our work we have ever had the most generous confidence shown in us by the men of Canada and especially from her public men, including both Sir John Thompson, and Sir Wilfrid Laurier, whose wives have been our Vice-Presidents.

Well, then, for a few of the achievements of the National Council of Women of Canada :—

1. It obtained the introduction of manual training into the schools of Ontario, and subsequently the training of the teachers to be able to give this instruction. Curiously enough, for so practical a country as Canada, there was a curious opposition to this policy, and a disposition to confine the meaning of the word education to what could be learned in books. My latest news from Canada on this subject I received a few days ago from Mrs. Hoodless, an enthusiast in this department, and she tells me that now every school in the Province of Ontario has been fully equipped for carrying on instruction in domestic science.

2. It has obtained the appointment of Women Factory Inspectors for factories and workshops where women are employed, in the Provinces of Quebec and Ontario.

3. It has obtained the extension of the provisions of the Factory Act to the Shops' Act in Ontario as regards the supervision of women workers, and is taking steps to promote the same extension in the Province of Quebec.

4. It has obtained the appointment of women on the Boards of School Trustees in New Brunswick, and the amendment of the School Act so that they may be elected in British Columbia. It has also compiled a report on the regulations and methods of electing members of School Boards in all the seven provinces in which much variety exists.

5. It has brought about very desirable changes in the arrangements for women prisoners in various places.

6. It has organised in various centres Boards of Associated Charities, or other systems of co-operation in the relief of distress, and is still working in this direction wherever it has opportunity so to do, and has circulated a valuable paper on the problem of the unemployed.

7. It has established hospitals in some of its smaller centres.

8. It first originated the idea of the Victorian Order of Nurses, which though at first difficult of establishment, has become a valued institution, and has greatly developed under Lady Minto's fostering care.

9. It inaugurated the National Home Reading Union.

10. It has held various enquiries into different subjects such as

(*a*) The conditions under which working women carry on their work ;

(*b*) The working of the Laws protecting women and children in the various provinces ;

(*c*) The circulation of impure literature and how to check it ;

11. It is concerning itself with the care of the aged poor, for whom often no sufficient provision has been made in a country without Poor-laws.

12. It inaugurated the National Home Reading Union to promote habits of good and systematic reading, and this Union is making most satisfactory progress.

13. At the request of the Dominion Government, it compiled a hand-book of information on matters concerning women and their work

for publication and distribution at the Paris and Glasgow International Exhibitions, a publication to which I would refer you if you desire information and statistics with which I do not here trouble you.

I think that I have proved that what I told you about the efficiency of the work of Canadian women was not an exaggeration. I have but touched the fringe of my subject. I should have loved to tell you more of the friends and fellow-workers to whom I owe so much. I should have liked to have drawn you a picture of the May Queen's Court at Ottawa, formed by the bright young maidens of Ottawa society, who elect their Queen every year, and who, under her guidance, associate themselves in all manner of ways for mutual improvement, mutual helpfulness, and for the help of other girls not so happily placed. I could tell you also of what women are doing in literature, in art, in music, and of the Women's Historical Society which is preserving many old landmarks, and also of the great missionary work which the women of the various churches have carried on, and of the work for the Indians. I wish, too, that I had time to talk to you of the good Sisters whom we meet in every part of Canada carrying on their devoted labours. And it would have been a real joy to describe with some fulness the ever growing and beneficent work of the Victorian Order of Nurses, whether in the wilds of the Klondyke, or in the cities and districts of the older Provinces. But, at least, I trust that what I have said has left the impression that the daughters of Canada are worthy of that land of sunshine and of promise, and that women who are seeking a new home will find no better country, nor one where they will have fuller scope for the exercise of all their abilities.

DISCUSSION.

The CHAIRMAN thought he expressed the opinion of the audience when he offered Lady Aberdeen their grateful thanks for her most interesting paper. She had given them glimpses of the past history of the great Dominion and its present development. The first fact mentioned by her was to him entirely novel and surprising. He had thought that the condition of the Indian squaw was a pattern of family degradation, of mere work and submission to the will of her lord, who permitted but did not pay honour to her existence. But it appeared in point of fact that select women had the privilege of choosing the chief, so that it might be said in almost the prehistoric period of Canadian history that woman franchise existed in the highest and most personal form; they did not have to choose members of the House of Representatives, but chose the Prime Minister and the ruler of all. Passing from that period Lady Aberdeen dwelt for a time upon the arrival of the French, the Normans, and the Britons, with their priests and the women who accompanied them devoted to the service of the Church. Perhaps the proudest boast of the Catholic Church was that it afforded the widest sphere for the consecrated service of women. He was interested in the whole of Canada, but nothing had struck him more in the contemplation of it than the existence of the French people and a French province, forming an undisturbed and great fragment of the magnificent whole. There was nothing like it that he knew on the face of the earth; he was not sure that history had ever presented anything parallel to it—a large province wholly inhabited, with the exception of a small portion on the border, by the French, clinging to their old customs, devoted to their catholic religion, keeping up their own language, their own separate laws, their complete organisation, their old politics, their old charm, their old sobriety and dignity of domestic demeanour. He did not know whether Lady Aberdeen had ever felt as he had, but in passing from the almost too industrious and turbulent Northern States of America, and even in passing through Western Canada, with its thriving, enterprising population, into the provinces of Quebec, he had felt a soothing and comforting charm by the spectacle of virtues so different from those from which he had come, so full of repose and satisfaction. The French in Canada could not maintain their position and those virtues unless the French women kept up the traditions which their ancestors brought with them from Northern France. Speaking as a politician, he would add that the extraordinary spectacle of a satisfied and contented people dwelling under the rule, slight and nominal as it might be—absolutely nominal in regard to internal affairs—of a potentate of another race and language was only explicable by the fact that there one found verified what Sir Wifrid Laurier had said: "Canada is a daughter in her mother's house, a mistress in her own." He dwelt upon that because on his first visit to Canada he was immensely struck by a circumstance which had ever since survived in his memory, and perhaps had exercised a considerable influence from time to time over his acts. He was journeying in a most comfortably furnished steamer from Quebec to Montreal, from the old historic capital to the industrial capital of the province of Quebec. He had been steeped in the French traditions of Quebec the day before, and had been astonished to see on the shores of the St. Lawrence a city which, in its picturesqueness and charm, was equal to much that might be found in France itself; indeed, in some respects, preserved characteristics which had passed away in France. Coming up early in the morning

on the deck of the steamer he saw a fellow-passenger standing at the prow, whom he recognised as a fellow-traveller whose acquaintance he had recently made bearing a great French name, carrying one back to the palmy days of the old French kingdom. He was surveying the land, and he could not help wondering to himself what the man's thoughts must be, to be passing amongst his own people, with traditions everywhere of the domination of his own race, and to find it entirely passed under the domination of another authority. Sympathy with that man could only be preserved by respecting the freedom of the Canadians of to-day, and the realisation of the passing wonder which was not sufficiently realised even by our best informed men here, of the unique position of French Canada as a part of the Dominion. The French race in Canada was not a dying race. Under the constitution of the Dominion of Canada, the representation of the province of Quebec in the House of Representatives was fixed for a certain number of members. The representation of the other provinces varied, bearing the same proportion to the representatives of the province of Quebec that the population of the other provinces bore to the population of Quebec. When the Dominion Act was passed it was supposed that the representation of Quebec being absolutely fixed, and the other provinces getting more and more thickly populated, the other provinces would, every ten years when there was a revision, receive an addition to the number of their representatives, their numbers growing whilst those of the province of Quebec would remain stationary. But the last census of Canada brought out the most unexpected fact that the French of Quebec had increased in population more than the rest of Canada, so that instead of increasing the representation of other provinces in the Dominion in the House of Representatives, the other provinces had to undergo a diminution of numbers in order to bring down their numbers to the proper ratio. In connection with the French population, there was another breed, which, in his judgment, had had a great deal to do, and would have a great deal to do, in the creation of Canadian society and history in the future—the Scotch. They had played an important part in the past; they were playing a more important part in the present than any other race from Great Britain or Ireland which had gone over into Canada. Their politicians, the Galts, Mackenzies, and Macdonalds, preserved a perpetual remembrance of the Scotch influence, and somehow, unconsciously through a due sense of the fitness of things, there had passed over to Canada, as Governor-Generals, Scotch peers, Campbells, Gordons, and Elliots to rule over Canada. It was the Scotswoman in the Scot settlements in the farms which were scattered about, first in Ontario, now further west in Manitoba, and British Columbia, and the Scots housewife who was silently building up the constitution and the society of Canada of the future, and in those people was to be found the secret of the greatness of Canadian society in the past. Lady Aberdeen had spoken of the way in which action had passed on through scattered households into cities, into societies, into unions, into co-operations, so that now there was a set of societies organised together forming a great national union of workers throughout the whole of the dominion, where women were making their places in the school, in the care of the sick, in attention to the poor, and in the building up of societies throughout the whole country, and bringing out the real development of the Canada of the future.

Mrs. Boomer said she was glad that Lady Aberdeen, before speaking of the Canadian women of to-day, had gone far back to the beginning of things, and paid so fitting a tribute to the heroism and self-sacrifice of the women of those pioneer days that the audience would the more easily recognise from whence came the firm unbendable backbone which seemed to be the heritage of their descendants, making them the resourceful, self-reliant wives, mothers, and daughters who were to be found from the shores of the Atlantic to the Pacific. Lady Aberdeen had given Canadian women a high meed of praise; nothing had escaped her observant eye or her sympathetic heart. No one feared being "caught in the rough" by either Lord or Lady Aberdeen, as one might judge by her story of the typical girl who first cooked the dinner, then waited on the guests, and afterwards, in dainty attire, probably made by her own deft fingers, spent the evening in social enjoyment with the honoured guests upon whom she had so gladly waited. What that girl did was only what hundreds of Canadian girls unhesitatingly did over and over again as emergency demanded, without losing one atom of their own self respect or being lowered one inch in the estimation of others. She knew well, too, that other lady who, with her daughter, frequently did all the work of her home, her dairy, and also superintended in her husband's absence in Parliament a good deal of the outside work of their ranch, but who had not changed from the dainty woman of culture she always was, but was rather by it the better trained for her philanthropic activities, and for becoming what she was, a model President for her branch of the National Council of Women. She was glad Lady Aberdeen had mentioned the aims and objects of the National Council of Women, which she (Mrs. Boomer) represented, but she had not mentioned how much it was indebted to herself (Lady Aberdeen), not only for its very being, but for the inspiration which she wafted over to them, from time to time, across the Atlantic. When Lady Aberdeen had to leave Canada, dismal prophecies were made of the utter collapse of the movement, but she had laid too firm a foundation, and to-day she could rejoice at the realisation of many of their hopes. Much of the success which had crowned the efforts of the Women's Council was due to their adaptation on a large scale of the

commonsense plan of the old man who smoked red herrings for a living—"Its this way in my herring house. If I put one stick that won't burn; if I put two they may burn; if I put three or more they will burn." Mrs. Boomer said that she had personal knowledge of the unspeakable boon which Lady Aberdeen, its founder, had bequeathed to Canada when she formed branches of the Victorian Order of Nurses in various localities from one end of the Dominion to the other. They had been already a benediction to many, and would be to thousands yet unborn. The Aberdeen Society had also become an untold blessing in the far-away homes of the big North-West. The railway companies were so in sympathy with the movement as a factor in the happiness of the people that they offered exceptional facilities for the transmission of the magazines and books sent through the branches of the National Council of Women. The teaching of domestic science had had immense impetus given it through the Women's Council, each local branch making it a live issue. She believed the established schools of domestic science in the Dominion would compare favourably with any in the mother country, and so also would the woman's department in agricultural colleges, dairy training, bee and poultry culture, &c. Largely through the National Council, the Canadian woman of to-day was beginning to understand that she had definite duties and responsibilities towards her city and country, even though her powers of expression were limited. Her awakened conscience reacted upon her intelligence, and although as yet she was but in the infant school of her new teaching, she was fast passing on into the higher standards, and as new opportunities opened up for her she would surely gain strength by experience, and a recognition be given to her mental capacity, which might end in her being, before very long, deemed worthy of being entrusted with even the Parliamentary franchise. She might not live to see it, but it was as surely coming to the women of the Colonies as to the women of the mother country itself. Of course, women who had the necessary qualifications, already had the municipal vote and the vote for school trustees, and in some provinces, a seat upon the school board of their city or town. The value of being an organised body came in there. Its members bestirred themselves, when action called for it, to get their shy women to the poll to record their votes according to their consciences. As far as possible they overruled fanciful objection to the mere act of slipping a ballot into the box an objection easily met in temperate, orderly Canada, which allowed no public bar open on election day, and provided voting centres within easy access of nearly every section of the city. Lady Aberdeen had referred to the growing recognition accorded by leading men to the efforts of the Women's Council, for which they were thankful. They were still misunderstood by some who, having once and for all denounced what they were pleased to call the "new woman," would not reconstruct her for the world. Those in authority who thought well of them, and they were in the majority, used them as they were glad to be used. Through their committees, valuable information was obtained, and they always accorded a patient and attentive hearing to petitions when they were presented, granting them when they recognised that to do so would be for the public weal. In that way the Women's Council had been able to throw its ægis around poor little children who had been more sinned against than sinning by getting raised the age of consent; by obtaining legislation in the interest of the little lads of the nation in restricting by high licenses, &c., the sale of the deadly cigarette, by getting covered ambulances in smaller places where none existed, and covered "Black Marias" instead of the open vans in which intemperate women — they were but few in temperate Canada—had hitherto been carried through the streets to the police-station under the public gaze. Hospitals had been entirely built and furnished under the auspices of the National Council of Women in various parts of the Dominion; there was also a Bureau of Information and organised methods in several centres for the assistance of women immigrants. Amongst their valued affiliated societies were the several teachers' associations, and through their influence a spirit of loyalty to king and country and of pride in the wonderful resources of their own land were fostered and encouraged in the growing generation. It was not necessary to speak of the loyalty of the women of Canada, as strong now as in the days of Laura Seccord and the patriotic women of whom Lady Aberdeen had spoken. Not a mother sought to keep back her son, not a sister a brother, not a Canadian girl her lover when the late call to arms sounded. Then it was a matter of but a few days for the Women's Council to organise Red Cross branches throughout the length and breadth of the Dominion, and of mere hours, to fill those magnificent bales with every possible requisite for "our boys" in the field. Lest it should be thought she spoke too boastfully of her adopted country, Mrs. Boomer wished to acknowledge that there were some things almost unattainable there, mainly because of the difficulties which confronted those who sought them. For instance, there was divorce. Since confederation in 1867 there had been only 200 divorces, and for those there must have been the very strongest reasons, incompatibility of temper certainly not being one of them. The law in Canada did not meddle with minor matrimonial differences, and left a married couple to cure or endure their bad tempers as best they could. Even when divorce was granted, she believed the guilty party could not re-marry, which seemed, to the uninstructed mind, a righteous verdict. After quoting an amusing instance of the primitive Indian law in regard to wife-beating, the speaker added that since she had been in Great Britain she noted how difficult it was for the untravelled British eye to get into proper focus when

taking an imaginary survey of Canada; it could not take in its immensity; whilst the people in Canada, on the other hand, pondered over the problem of the disproportion of people to space which seems to be at the bottom of so much of the destitution in the mother land. Surely the welcome Canada held out should be its best remedy. Canada had much land to be possessed, and was fast earning its name of the world's granary. Miles upon miles of golden corn would soon await the sickle, but the labourers were proportionately few. Meanwhile stalwart men marched through the streets of London crying "Give us work, give us bread" and Canada had both and to spare. To such she extended a cordial invitation.

Mr. PRESTON (Commissioner of Emigration for Canada) thought Lady Aberdeen had, by writing the paper, added another column to the debt of gratitude which the people of Canada owed to her,—a debt which he feared they would never be able to repay. He believed they had in Canada the highest type of womanhood. He was satisfied that nowhere in the wide world, taking women as a whole, as a class in every walk of life, were they mbued with a higher aspiration after what was grand and good and noble than in the Dominion of Canada. He thought that was due not a little to the educational facilities offered in the country. In the public schools he had seen the children of the millionaire sitting side by side with the children of the artisan; and he could take anybody to some of the great schools of the Dominion, and would defy them to arrive at a conclusion, from the appearance and the dress of the children, as to who was the child of the millionaire and who was the child of the artisan. The children were well dressed and singularly bright, the emulation given to them by rubbing shoulders one with the other, stamped itself on the life and character of the child growing into manhood or womanhood, and was carried by the man or woman all through life. To that was due, in no small measure, the force of character which was evident all through the women of the Dominion. Not only did the children go to the common school, but the high school was open to them as well, and from the high school the university, and from the university to the professions. When he left Canada three or four years ago there was at least one lady barrister in Toronto who had a good practice, who was quite able to appear before the High Court in the province, arguing on behalf of her clients upon many intricate questions of law. There were several ladies in the medical profession reaching a standard and securing a practice which he thought any professional gentleman in London might envy. For those reasons he thought he might fairly claim for Canada, as the outcome of the educational system, a type of womanhood which was as high or higher than was to be found in any other part of the world. There was in the province of Ontario, and, in fact, throughout all Canada, a more pronounced sentiment upon the liquor question than there was anywhere else in the world, and that was very largely, if not altogether, due to the active crusade which the women of Ontario and other provinces had carried on for so many years. The evil effects of intoxicating liquors were taught in the public schools. As a boy he remembered that in his schoolboy days he had an antipathy to intoxicating liquors; but he was amazed to find one day, when his own boy came home from school with a book on the liquor question, that not only had he a great antipathy, but actually hated and loathed it, as he pointed out what he had learned in the public school upon the question. That book was introduced into the public schools very largely through the influence of the women of the province of Ontario. In the same province the liquor question had long since been settled. The province 25 years ago had 6,000 odd licences, but to-day it had less than 3,000 with a population double what it was previously. Why? Because the women had endeavoured to impress upon the public men of Canada the evil effects of over indulgence in intoxicating liquors, and asked them to do something whereby they might save the rising generation from the perils due to an apparent indifference on this subject. He also claimed that in Canada there was a higher appreciation, admiration, and respect for womanhood than there was in Great Britain. In conclusion, he desired to thank Lady Aberdeen on behalf of the Government and people of Canada for the continued interest she was taking in the Dominion, over which for so long she presided as its social head. In the colonies from time to time they had occasion to complain of Downing-street rule; but they had nothing to complain of in respect of Downing-street's selection of the long list of Governors who during the last half century had been associated with Canadian history; and amid the honoured occupants of the viceregal residence at Ottawa not the least among them were Lord and Lady Aberdeen; and he thought it would be acknowledged by those who had preceded Lady Aberdeen in the occupancy of Government-house none of them had left a higher, grander, or nobler stamp upon the character of the people of Canada than had the Countess of Aberdeen.

The Hon. Sir JOHN COCKBURN said that the women of Canada were greatly to be congratulated on having such a brilliant and sympathetic historian, and although they only had the inestimable privilege of association with Lady Aberdeen during the course of her work in the Dominion, still the women of all colonies had to a certain extent shared in the benefit. Many years ago he had the honour of showing Lady Aberdeen over the schools in Australia when she was paying a brief visit to the Colonies. But the inspiration of Lady Aberdeen's influence was felt in Australia to this day, and only lately in South Australia a branch of the Women's National Council was founded under the magic of her name.

A cordial vote of thanks to Lady Aberdeen was unanimously adopted.

Lady ABERDEEN, in reply, thanked the members for the kindly reception given to her paper. It was always a joy to her to talk of Canada, and to feel herself in a Canadian atmosphere. She had felt herself to be in a Canadian atmosphere during the afternoon, and all the more because of the presence of the Chairman. She very much appreciated Mr. Courtney's valuable kindness in presiding, not only on his own account, but because he was the brother of Mr. John Courtney who was for so long the Deputy Minister of Finance in Canada, who not only found time to carry on his very heavy financial work, but to whom she and many others had always looked for guidance and help in all their undertakings for the public welfare.

ELEVENTH ORDINARY MEETING.

Wednesday, February 18, 1903; CARMICHAEL THOMAS, Treasurer of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Atherton, Rev. William Bernard, B.A., H.M.S. *Urgent*, Port Royal, Jamaica, and Taynton-house, Taynton, near Gloucester.
Blaize, Hon. R. B., Lagos, West Africa.
Brickwell, Alfred James, Great Northern Railway, Surveyors' Department, King's-cross Station, N.
Darby, William Evans, LL.D,, 47, New Broad-street, E.C.
Dennes, Donald, M.Inst.M.M., The Gold Coast Proprietary Mines, Limited, Accra, Gold Coast Colony, West Africa.
Kelly, William Lamb, care of British India Steam Navigation Company, Calcutta.
Krawehl, A., Anchor Brewery, North End, Port Elizabeth, Cape Colony, South Africa.
Leven and Melville, Earl of, Glenferness, Dunphail, N.B., and Roehampton-house, Roehampton, S.W.
Maclennan, John Donald, M.Can.Soc.C.E., 527, Garfield-building, Cleveland, Ohio, U.S.A.
Pidgin, Charles Felton, Gray-chambers, 20, Mount Vernon-street, Boston, Massachusetts, U.S.A.
Ruxton, Captain U. Fitz H., The Residency, Yola, Northern Nigeria, West Africa.
Stodart, Edward Herbert, 59, Barrow-road, Streatham-common, S.W.
Wheeler, Frederick, F.R.I.B.A., 6, Staple inn, W.C.
Williams, John Norman Spencer, M.I.Mech.E., Hawaiian Commercial and Sugar Company, Kahului, Maui, Hawaiian Islands.

The following candidates were balloted for and duly elected members of the Society: —

Beisenberg, H., Rathcote, Pattison-road, Hampstead, N.W.
Bell, James, 34, Kensington-square, W., and Guildhall, E.C.
Daw, John Williams, M.I.M.M , Ashanti Goldfields Corporation, Limited, 6, Southampton-street, Holborn, W.C.
Fraser, J. C., Messrs. Stephen, Fraser and Co., Limited, Port Elizabeth, South Africa.
Gould, Edward, care of Standard Bank, Barberton, East Transvaal, South Africa.
Mitchell, George, M.I.Mech.E., The Vacuum Brake Company, Limited, 32, Queen Victoria-street, E.C., and 59, Frances-road, Windsor.
Morgan, Edward Domett, A.I.E.E., 73, Wightman-road, Harringay, N.
Munro, John, O.K. Copper Mine, *viâ* Mungana, North Queensland, Australia.
Nanjiani, Khan Sahib K. R., Godhra, Panch Mahals, Bombay, India.
Quicke, William G., Assoc.M.Inst.C.E., Gas Works, Perth, Western Australia.
Tilden, Douglas, 1545, Webster-street, Oakland, California, U.S.A.
Townsend, E. Ross, Agricultural Offices, Salisbury, Rhodesia, South Africa.

The CHAIRMAN said that it was hardly necessary to introduce to the meeting anyone of the name of Dalziel who spoke on such a subject as this. But, for the information of those who did not happen to know Mr. Harvey Dalziel, he would mention that he is the son of Mr. Edward Dalziel, who engraved so many of the best books in the good old days of wood engraving. Mr. Harvey Dalziel studied at the Slade School of Arts, afterwards entered a printing office and worked his way up, till now he was the head of the Camden Press, which turns out very large numbers of prints yearly.

The paper read was—

THREE-COLOUR PRINTING.

By HARVEY DALZIEL.

I feel overwhelmed by the honour done me in being asked to speak before you to-night. I am deeply grateful to the Chairman for his kindly reference to my father, who worked hard for over 50 years in the interests of illustrated journalism.

I am not a scientific man. I am merely a practical printer and business man, keeping in close touch with my workmen and always on the look out for improved methods and appliances. I have had over thirty years' experience

Chromo Lithography.

INCOMPLETE PRINT.

ONLY THREE PRINTINGS SUPERIMPOSED.

In addition to the Yellow, Blue and Red here printed, five more printings (Flesh Tint, Light Blue, Pink, Grey and Brown) are required to give a finished print.

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SECOND PRINTING.

Chromo Lithography.

EIGHTH PRINTING.

Chromo Lithography.

FIFTH PRINTING.

Three-Colour Process.

THREE PRINTINGS SUPERIMPOSED.

PHOTOGRAPHED DIRECT FROM A WATER COLOUR DRAWING BY P. JUSTYN.

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Three-Colour Process.

FIRST PRINTING.

SECOND PRINTING.

Three-Colour Process.

THIRD PRINTING

in the printing and allied trades. I always feel at home when near the rattle of printing machinery, but as I have never before written a paper, and as I have always been very successful in avoiding speech-making, I trust you will appreciate my position here to-night and bear with my deficiences.

I have tried to prepare this paper in language free from our technical trade expressions, in the hope that I shall make myself clearly understood.

I propose to compare the two well-known systems of colour printing — "Three-colour Process and Chromo-Lithography." Firstly, "Three-colour Printing," by which a perfect reproduction can be obtained from oil colour or water colour paintings, still life, or objects of art and manufacture, using only the three primary pigments, yellow, red, and blue, in three successive printings superimposed; and, secondly, Chromo-Lithography, which requires a large number of successive printings superimposed before a picture can be faithfully reproduced, there being sometimes used as many as fifteen separate colours and blends of colour for elaborate printing.

Seeing the marvellous results that are undoubtedly obtained by this three-colour process, it naturally (in the mind of the layman) raises the question:—Why is probably three-fourths or four-fifths of colour printing produced in this country (or made in Germany for use in this country) pure chromo-lithographic printing? Why does not this marvellous three-colour process entirely supersede chromo-lithography? It has been well known for over 10 years, and, certainly, when under favourable conditions, has been worked to perfection during the past seven years.

Mr. Carl Hentschel, one of the most eminent makers of three-colour process blocks in England, about two years ago, read you a paper on process block making; and in October of last year Mr. J. D. Geddes, of the famous firm of André and Sleigh, gave a most interesting account of tri-chromatic photography, and the manufacture therefrom of the three-colour process blocks, in relief, by means of the screen, for printing on letterpress machines.

Both these gentlemen are practical makers of these blocks. I am only a printer of them, but I trust it will not be considered presumptuous on my part briefly to outline the system of manufacture, as I do so only as a preliminary step before my explanation of the difficulties confronting the printers of such blocks, and also for the benefit of those in this audience who have not heard Mr. Hentschel or Mr. Geddes.

The intention of the three-colour process is based on theory that the three primary pigments, or inks, blended together—yellow, red, and blue—in specified proportions, are capable of reproducing all the colours of the rainbow, in fact everything in the way of blends of colour that the human eye can appreciate, and that the three printed solid over each other, first yellow, then red, and finally blue will give black, and that the pure high lights in the print shall be represented by the parts of the white paper, where no colours whatever are printed.

The first step is purely a photographic one. The picture or any object representing colours is placed before a camera with successively three filters between it and the sensitised plate.

Firstly, a red filter will absorb most of the yellow and blue in the picture, it being opaque to their influence, and *red* only of the picture will be recorded on the negative, solid where it is solid in the picture, and in the various degrees of strength according as red occurs in the different parts of the picture.

Similarly, as soon as the first negative is obtained, a second sensitised plate is placed in the camera with a green filter interposed. In this case the red and blue will be absorbed by the filter, and only the yellow and green in the picture will be recorded on the negative.

Finally, a third sensitised plate is placed in the camera with a blue filter interposed. This filter will absorb the yellow and red, and only the blue in its various degrees of intensity will be recorded on the negative.

We have now got three separate negatives representing all the colours and gradations of colours in the picture, dissected into the three primaries in all the various degrees of intensity in which they appear in the different parts in the original picture or object.

Now to obtain printing blocks in relief for letterpress printing machines, successively, positives on glass from these three negatives have to come before the camera as objects to be photographed. Between each one of these positives and the sensitised plate in the camera, is placed a ruled glass screen (strictly two ruled pieces of glass stuck together with rules crossing each other at right angles). This screen is used for the purpose of breaking up the object for etching purposes, and will record on the exposed

negative what will be a series of infinitesimal black dots in the high lights, rather larger dots in the half tones, and still larger dots in the tones, until the dots in the intense depths or shadows are so large, that they join together, so that a solid becomes almost solid, but with infinitisimal white dots on same.

This negative is then printed on to a metal plate, usually copper, and after artistic touching, filling in solids, and occasionally taking out high lights, &c., is then rolled up with an ink which will resist acid, and is taken to the acid bath, which with certain expert manipulation, etches the plate to a suitable depth for relief printing on letterpress machines. These three plates are then usually pinned down on three pieces of wood, making, with the plate, a height of nearly one inch (that is the height of type).

Very exquisite hand-press pulls are usually supplied by the three colour-process blockmaker, when delivering the blocks to the printer. I may here mention that there is no great difficulty in printing single copies from these three original blocks. But when these blocks have to be printed commercially, there are such problems to be worked out by the letterpress colour printer, as I verily believe have never been experienced by his brother craftsman—the chromo-lithographer. I will later on show that there are at present fixed limitations to the use of this process, but there can be little doubt, that for exquisite reproduction of artistic work, this process, when worked under favourable conditions, surpasses the finest possible chromo-lithography.

Having obtained our three-colour blocks, we have arrived at identically the same stage as when the lithographic artist has handed to the lithographic printer his, say 13 drawings on stone, representing, respectively, the three primary colours mentioned, together with ten other colours and blends of colours necessary for the accurate reproduction of a picture by chromo-lithography. The picture print I hold in my hand, "Their Majesties King Edward and Queen Alexandra," required the following 13 printings, superimposed successively one after the other, to produce the effect here given:—Flesh, yellow, maroon red, light blue, light pink, light grey, red, light brown, dark blue, dark brown, ultramarine blue, middle pink, and dark grey, *i.e.*, 13 printings *versus* the 3 printings of the three-colour process.

In the case of the three-colour process, you will note that the blocks are made in accordance with scientific theory which makes use of photography and mechanical etching, and, as a rule, this process gives a rendering of the original with more than approximate fidelity. If the reproduction shows defects, still, such defects are compensated for by the fact that we are looking at the artist's own work, and not, as in the case of chromo-lithography, at another man's conception of the original artist's work.

Of course, a certain amount of touching-up must be done to process blocks. Intensities of all or any colour block may have to be varied. The final result is not purely automatic. Judgment and dexterity in artistic touching-up is still necessary.

Now, I think I had better deal with the procedure of the chromo-lithographer. Admittedly the litho artist in producing his thirteen drawn stones has proceeded on no accurate mechanical scientific scheme of colour like that of the three-colour process. He first had to study the original picture and by past experience he worked out his colour scheme, and estimated a good result could be got with thirteen printings. I have seen some clever (though crude) results obtained by the lithographic artist in three printings. But although the human eye may be able to appreciate all the beautiful blends of colours, from solid colour to the very faintest tints, in the picture to be reproduced, the human hand cannot convey the eye impressions, first to the yellow surface, then to the red surface, and, finally, to the blue surface, and come within a hundred miles of the scientific analysis and dissection of the camera as already explained.

Now, I propose to give a comparative demonstration of printing by the two systems. Let us assume that the chromo-litho printer has machines large enough to print on a sheet, 40 inches by 30 inches, 42 duplicates of the "Monkey Brand" sheet before you.

This picture is printed in seven colours—yellow, flesh, light blue, brown, red, blue, and grey. (If he had machines for double that size, it would, probably, pay him better to print 84 at a time.) But we will not appear to take any advantage, we will keep to the sheet in front of us as it was actually printed.

He generally prints flesh colour first. His pressman will take 42 pulls on transparent transfer paper of the drawing on stone of the flesh colour, and each of these is accurately stuck in position on a skeleton key sheet already prepared (printed on unshrinkable

sheets on manilla paper or paper on thin zinc), and this represents the 42 exact positions in which to place successively all the seven colours, each colour being a group of 42. This skeleton key sheet with its 42 yellow transfers is impressed on to one entire lithographic stone or aluminium plate or zinc plate, which is then rolled up with ink and prepared for machine. The other six colours are all prepared the same way on six large stones, or on aluminium or zinc plates, and are printed progressively until the last colour completes the picture.

There are many classes of machines for printing chromo-lithography that give a very large daily output. But so that I shall not be accused of bias I will place the output at 4,000 sheets daily per colour of seven colours duplicated 42 times. You will readily see that this means a daily output at a rate of 24,000 perfect prints per machine (*i.e.*, 4,000 sheets of one colour multiplied by 42 the number of subjects, 168,000 and divided by seven, the number of colours in the completed picture equals 24,000). The firm, where that sheet was printed, took an order for 2,200,000 of that subject.

Large and continuous daily output in any printing office is a very material matter.

The chromo-lithographer is enabled to multiply machine running speed 42 times, because he can transfer successfully his 42 subjects or duplicates of the same subject as just described. Each original colour stone is hand-drawn by the litho artist who rarely uses stipple grain of more than 6,000 to 10,000 dots to the square inch. Though this seems very coarse as compared with a 166 three-colour screen, say 27,000 to the square inch, such coarseness is merged together and covered up by the larger number of printings. Forty-two duplicates or more of such open work of each colour can be successfully transferred on to a litho stone or metal plate without the stipple, chalk or medium work, or any detail, joining up or becoming blurred, and all the seven duplicated colour sheets shall register accurately on each other.

It is on this point that the three-colour process gets hung up, as a screen of 27,000 to the square inch cannot be successfully transferred.

A little while back I spoke of the process block maker's beautiful hand proofs sent to us printers with the three-colour blocks. There is no insuperable difficulty in printing to perfection properly made three-colour process blocks: but the attempt to obtain a large number of prints in a short space of time, and so compete commercially with chromo-lithography, is the cause of much of the wretched three-colour printing that is circulated in this cocntry.

Now, let us assume we are printers, and have been supplied with Three-Colour Process blocks of "Monkey Brand," and that our customers want 2,200,000. If we put three small presses on the job, with the view to print equal to the single copy impression supplied by the Process block makers, and run these three presses with an output of 4,000 daily, we would take 550 days to execute our customers' order. We cannot transfer 42 on a sheet like the chromo-lithographer, because it is necessary to use a very fine screen (about 150 to the inch lineal) in the three-colour process, and the pressure necessary in transferring blurs these microsopical dots together. What must the poor letterpress printer do. He must get either the electrotyper or a stereo-typer to take moulds of his three blocks, and supply him with duplicates in metal—the former a copper shell, tinned and backed up, the latter a stereotype casting, nickel faced.

Well, if he order 42, may Heaven help him. As I have already said, the best work can be printed from one at a time. As you add to the number of duplicates, so the difficulties will be increased.

Most practical letterpress colour printers would be able to put eight sets on machine, and if the duplicate electrotypes or stereotypes are well made, good results should be obtained. The printer would arrange the first eight yellow blocks on machine with the required margin between the blocks, filled up with printer's furniture. This is a fairly simple matter. But when the eight red blocks come to be imposed on machine, so that each one shall print (practically speaking, dot on dot) on its corresponding block, why then the fun commences. Of course the first superimposed impression shows that each red block is wrong; some have to be shifted north, some south, some east, some west. Then another impression is taken, and further shifting of blocks, and so on, and so on. Then the same thing has to be done with the blue. The difficulty of the printer is often intensified by the fact, that say, the electrotypes of the red have shrunk more than the electrotypes of the blue, or vice versa, and if either be so, all the fiddling about and adjusting will not mend matters.

There is nothing unusual in two or three days

of a man's time, together with the time of a valuable machine, being wasted in this way before starting printing, whereas, on the litho machine, each stone containing 42 subjects in perfect register, can be started printing in two or three hours.

During these two or three days wasted, the chromo-lithographer will have been producing at the rate of 24,000 copies daily. And when the three-colour process, with only 8 sets of block of each colour, with an output of 4,000 sheets per day per colour, are running on machine, they will only be producing at the rate of 10,666 perfect prints per machine per day, as compared with the output of 24,000 perfect prints by the chromo-lithographer.

In consequence of the unreliability of electrotyping for this process, many printers, when good results are expected, go to the expense of buying two sets of original three-colour blocks, at a cost of about 3s. 6d. per square inch, instead of electrotypes at about 3d. per square inch.

In addition to the necessity of absolutely perfect register of red on yellow, and of blue on yellow and red, there are certain other conditions absolutely essential to printing the three-colour process successfully.

Pure pigment must be used. The red should be pure and must have no trace of either violet or orange. The yellow must have no trace of red, orange or green; it should be pure lemon yellow. The blue should be pure cyan-blue, and neither violet nor green should preponderate. The red and blue must be somewhat transparent. Most careful attention to inks is absolutely necessary, having regard to the fact that every imaginable blend from three pure primaries is demanded by this photographic production.

The paper should be unshrinkable and well seasoned, of the very best quality, pure white, hard sized, and well-glazed surface.

As soon as the blocks are got in register they must be underlaid until the face impression of the eight blocks is absolutely level. The packing on the cylinder should be hard, and as a rule not more than two thin pieces of paper should be cut out ("overlaying") and pasted over the impression of each block. This is done to force the solids, and to soften the tones and edges.

Of course sheets must be laid on to machines with unvarying accuracy, the machine impression must be perfect, with cylinder and bed working in absolute unison, and with a capacity for perfect distribution by composition rollers, which latter must be kept in good condition and free from damp. If there be the slightest variation through defective inks, or distribution of inks, results will be disastrous. For instance, if the yellow be too strong and the red too weak, black and deep purples would be absent. If the red be too strong and the yellow too weak, there would be an absence of green and a general appearance of a conflagration. I give these two examples assuming the blue to be all right, but if the blue be wrong other peculiar effects occur.

If all the essential conditions be fulfilled, a perfect production of almost any picture can be obtained. But if anyone of these conditions be unfulfilled the gradations and perfect blends of every imaginable kind of colour possible by this photo-mechanical process are lost.

Now in chromo-lithography, slight discrepancies are easily made good by the litho artist preparing an additional stone to overcome any such defects, and this extra printing will generally put things right. But in this three-colour printing, if there be the least discrepancy, the whole scheme of colour is lost.

The three-colour process is a most fascinating one for all printers. In addition, it is capable of the very finest work; it produces faithfully the actual brush marks of the original painter. In truth, it might be said, you are looking at the work of the master.

But the artist must finish his picture with greater care (if the production is with a view to please the general public). As an instance I draw attention to the seascape supplement to the Society of Arts *Journal.* I need only point out a brush mark in the top left side where the water colour has run and dried hard at the edge. This photographic process has copied this blot or blob faithfully. The lithographic artist could have softened that edge. The former rendering would probably be preferred by the educated artistic eye, but the latter by the bulk of the public. Many buyers and users of colour printing still prefer those pretty stippled smooth effects which the lithographic artist is so adept at.

The lithographic artist can produce a finished looking print from a less perfect oil picture or water-colour drawing, much in the same way as in the old days wood engravers were able to produce blocks yielding a finished print that would satisfy the public eye, and often from a mere sketch on wood by the original draughtsman.

In chromo-lithography you are not looking at the actual work of the original artist, but at the handiwork of the copyist.

Although, undoubtedly, for the last six or seven years, the three-colour process has given us the most perfect results from oil paintings and water-colour drawings of portraits, landscapes, and still life, and from objects themselves direct, articles of manufacture, landscape direct, houses and gardens, river, scenes, &c., even from the model direct (a very steady sitter), the bulk of colour printing can still be more cheaply produced by chromo-lithography.

During the past six or seven years, chromo-lithographers have not been idle. Instead of printing from stone on slow flat bed machines, good results and increased output are obtained from aluminium plates on rotary machines, and some rotary machines in America print six colours at the same time at a high rate of speed.

Also excellent results have been obtained by transferring litho designs on to large thin zinc plates and printing them on fast running letterpress machines, by using the Wharf-litho system of etching, the white parts with such a microscopical grain that they will not accumulate any ink from the inking rollers thus leaving the white parts of the paper clean.

I believe that the three-colour process will hold the field for real artistic colour printing. With proper filters and all accessories the camera, broadly speaking, will only portray what the artist has put into his picture, with a perfect picture before him, the lithographic artist should make himself absolutely subservient to the original artist, and enter whole soul and spirit into faithfully reproducing the work. But even then his work is only a copy, and he cannot always grasp the true feeling, the form and colour which the original artist has striven for and succeeded in obtaining. And the disconsolate painter often finds his ideals—light and shade and colour scheme—gone, sometimes harshness, sometimes angularity or the reverse in the shape of soaped down softness.

Referring again to the three-colour process, when bad results are obtained, the process-block maker always blames the poor printer. Certainly the block makers can teach the printer nothing in the way of printing. The block maker supplies a perfect print with the blocks and thinks the printer should print in bulk like his proof, but, for the reasons already given, printing a large number of subjects on a large sheet successfully is beyond the scope of the three-colour process. That is the fault of the process and not of the printer.

What I do blame the printers for, is that so many attempt the impossible feat of printing several subjects at once on large sheets, and so bring discredit on what may almost be termed an ideal process when worked under favourable conditions.

All sorts of remedies have been attempted by printers to get over the difficulties of printing three-colour process satisfactorily and competing successfully, both as regards quality and price, with chromo-lithography, but I think the remedy will ultimately be found by the three-colour process-block makers themselves. I think the three-colour process may possibly supersede chromo-lithography for all classes of colour printing, when printers can obtain from the block makers three entire, large metal sheets containing a large number of subjects or duplicates of the same subject—that is, a large yellow plate, a large red plate, and a large blue plate, with all the subjects, say 32 or 64, photographically printed and etched thereon in perfect register. At any rate, this would be one important step towards the general use of the three-colour process.

An entire plate such as this, with large white spaces between the subjects, can be cleanly printed on letterpress machines by adapting the Wharf-litho etching process for all the white parts.

The two supplements to this number of the *Journal*, were printed with the intention of showing how far the yellow, red and blue stones of the chromo-lithographic artist (when he has five more printings to complete his print) go towards a finished print, as compared with the results of yellow, red, and blue blocks of the three-colour process. (The latter supplement being a specimen of three-colour blocks by Messrs. André and Sleigh).

If the lithographic artist, Mr. Frederick McQuire, had been asked to give a picture in three colours only, he certainly could have drawn, in a somewhat crude style, much more than is here shown. With his three colours he would have filled in a great deal more of the surfaces of these stones, but he would not have pretended to attempt an accurate representation of all gradations and qualities of colours. He would merely have given a rough print, somewhat on a par with the "penny plain, twopence coloured" prints of yore.

As regards the Three-Colour Process blocks of the seascape yellow, red and blue, each colour pervades, more or less, the entire picture, solid in some parts,

and almost infinitesimal in other parts, but all parts of each block doing their duty, in proportionate density or lightness of printing surface, and producing not only every colour and every blend of colour, but both colours and blends of colours in every required degree of density and of lightness.

Thanks are due to the following gentlemen and business firms for specimen prints, &c., exhibited :—Messrs. Carl Hentschel, André and Sleigh, John Swain, Frederick McQuire, George Jones, Stafford of Nottingham, and Algraphy, Limited, the Multicolour Printing Company, and Orloff Printing Company.

DISCUSSION.

The CHAIRMAN said they had heard with much pleasure the paper Mr. Harvey Dalziel had been good enough to give them, and in reference to it they would all agree that it threw much light on the very interesting process of colour reproduction. Photography had caused such a very great revolution in black and white work when wood-engraving was done away with, and the half-tone process came to the front, that it was only to be expected that the next thing to be attacked would be coloured pictures, and it was astonishing how soon the three-colour process had come forward, and what excellent results were now obtained. He had just been shewing some gentlemen an original water-colour and a proof which he had had framed in exactly the same way, and only two out of six could tell which was which, although they were all men who knew a great deal about the subject. It seemed to him the printer must put his back into the work. In former days, if one got one of the reds, out of say five or six, a little out, it did not matter much; but that was not the case nowadays with only three printings—red, blue, and yellow. If the register was not right, the result was apparent at once in the finished proof. The peach-like bloom on the maiden's face—if the blue was too strong, became purple—quite a different thing from what was expected in the publication.

Mr. CARL HENTSCHEL said there was no doubt that, as Mr. Dalziel had remarked, the three-colour process would supersede for high-class work chromo-lithography. For book illustrations there was a large field for it; and what was wanted was that printers should take more interest in printing three-colour blocks. It was curious to note that the Scotch printers at the present moment were ahead, and taking more interest, than the English in three-colour printing. Mr. Dalziel had pointed out that there was a difficulty in printing more than one three-colour block at a time, but he (Mr. Hentschel) would like to refer to the books published by A. and C. Black, specially those of Mortimer Menpes, and Talbot Kelly, which contained something like a hundred illustrations, those illustrations being printed, not singly but all in sheets of eights. For certain work, no doubt, chromo-lithography would have its day, but he believed that in the future the three-colour process would certainly create a great revolution. It was hard that in England they should have to face the difficulty of getting good electros. In America, far better ones were got than could be got here; and in this connection he thought there was no doubt that it was difficult to get the men here to take that keen interest in the work which American workmen displayed, and also there was the fact that the printer and publisher had a fixed idea that the price for an electro is a penny a square inch, and they declined to pay more. Personally he would not undertake to let them have them at a penny per square inch, and when anyone asked him for it he told them it was threepence per square inch, but the reply was always the same, "Oh, I can get it done for a penny," and the result was that when the artist sees the picture he says, "Good heavens! I don't want any more three-colour work." In regard to the reproduction of gallery pictures, it was very difficult in the present state of the process to take a camera to the National Gallery and reproduce successfully. The majority of gallery pictures put on the market had not been successful, and had not done the three-colour process work much good, for the reason that many people did not realise that for such work a powerful electric light, and a steady light was wanted, whereas in the galleries they had only daylight to depend upon, and they knew what that was in London.

Mr. JOSEPH PENNELL said he had learnt lots during the evening, for he had never before heard the subject discussed by the printer. He thought Mr. Dalziel should be more considerate of the poor artist, for that was where all the work came from—from the poor artist, who is very little consulted, and who has very little attention paid to him or his complaints, which are mostly justified. He had never seen such a lot of abominations in all his life as he had seen that night when he looked round the room, but there was a picture of the King by Mr. Hentschel which amazed him, and if it was done without hand-touching it was really an astonishing production. The trouble was that most of them were not so done, for even the poor artist was called in to help the printer and other people to set them right. Of course, there were two people who worked at chromo-lithography—one the chromo-lithographer and the other the artist—and if the author would look at the work done abroad, he would find most wonderful things, with which the lithographer had nothing to do, which accounted for a great deal. It had been said that the three-colour process could reproduce all the colours of

the rainbow, but if they were all reproduced, the result would be black. As to thirteen drawings being made by the artist on the stone, he had never heard of that—he had heard of twelve drawings and one transfer, but never of the other way. It might be done, but he saw no necessity for it. The author had admitted that most of the English work in three colours was wretched, and he (the speaker) quite agreed with him that it was wretched. As to hard sized and well glazed paper he could not imagine anything much worse.

Mr. HENTSCHEL, replying to Mr. Pennell, said that the large picture of the King which appeared in the *Graphic* was reproduced by the three-colour process, and without any hand touching.

Mr. GEORGE JONES said that he wondered where the poor wretched printer came in after the block-maker and the artist had had their say. He had listened with much pleasure to the paper read, but he did not agree with Mr. Dalziel all along the line. For instance, the author had referred to the "Monkey Brand," and had maintained that the printer could not for the moment compete in lithography work like it. Some were obliged to do work like it for the moment. The block-maker had been putting it upon the printer; but he, as a printer, would put it upon the block-maker. If only the original plates were reproduced they would print them. Mr. Hentschel had said something about the Scotch printer doing his work better than the English; but Mr. Hentschel knew that was not a fact—he was giving it him straight from the shoulder. There were men in London who could well compare as craftsmen with their friends north of the Tweed. He had nothing to say against Scotsmen, and, in fact, he was half a Scotsman himself, and was in touch with some of the best printers in Scotland. It was true that there they were putting all their heart into it, but he thought they were doing the same south of the border. The secrets of good three-colour printing were: Study your object, put your back into it; use the best materials possible for the work, and demand a fair price for it. He would not sit under the stigma of being a wretched printer. If he could not turn out a good bit of three-colour work he would not touch it. But Mr. Hentschel had good reason for his strictures, for there was a lot of awful stuff going about under the name of three-colour process—but then there was an awful price paid for it. If a man would only give eighteen-pence for that for which he ought to pay six shillings then he must have such stuff. Speaking for himself he was pleased to say it had been his pleasure and his privilege to print three-colour Christmas postcards and send them over for consumption on the German market. But he was not there that night to say the three-colour process was going to do everything that could be done; the sister art would always do something better than the three-colour process; but there was plenty of room for both to do well in.

Mr. VINCENT BROOKS, speaking as a lithographer, said that he wished to place before them one point of considerable importance which bore on the question of easy reproduction by electrotyping of three-colour blocks. In America the work was largely done by Mr. Louis Levy's acid-blast process. It was worthy of note that this system gave an entirely different result when looked at microscopically, from that given by the ordinary method. Certain particulars of it had appeared in the "International Printer" of last September; and it did seem to him that considerable development would take place when block makers adopted this method, which showed so much promise of progress. Instead of standing in front of a trough and rocking it, the plan was to cover the plate and have a high power acid blast blowing from under the plate. The result was surprising. A cone or inverted pyramid was obtained, and when magnified 20 or 30 powers the result was remarkable, there being, also, not the least undercutting. When that was pressed into any material, it could be removed at once, so that there was a much better chance of getting a good electrotype than at present.

The CHAIRMAN, in proposing a vote of thanks to Mr. Dalziel for his paper, said that he thought they all had got something to learn. As regarded the three-colour process, although wonderful things were reproduced it was always a bit of a toss-up how a thing was going to turn out; but the process was in its infancy, and there was no doubt that, with care, the results would become better and better.

A cordial vote of thanks was then accorded to Mr. Dalziel for his paper, and Mr. Dalziel having thanked those present for the welcome extended to him, the proceedings terminated.

Miscellaneous.

TRUSTS IN GERMANY.

Trusts have increased to such a degree, and the extent of their operations is so far reaching, that the Imperial Government has decided to institute an investigation into their formation, organisation, and effects upon trade and consumption. In one of the recent debates on the projected new customs tariff, Count Posadowsky, Prussian Secretary of State, declared that, in addition to the information already

collected, the Imperial Government had decided to hear not only the opinions of the representatives of the principal Trusts, but also those of independent authorities on the subject. The Government wishes to be accurately informed of the influence of the Trusts upon the normal development of industry and trade, with special reference to their action during periods of industrial depression. The final results will be made known in a special official publication, and are eagerly expected by the interested parties on both sides.

Although it is generally unknown, the origin of Trusts may be traced back to very early times. The Justinian Code, for instance, forbade, in the public interest, certain combinations of merchants and artisans, and in the Middle Ages the Trust movement had attained such a development that certain combinations of merchants were able to decree the sinking of whole cargoes of spices into the sea in order to diminish the supply and thus maintain or raise the level of prices. The organisation of the Trusts during and after the Middle Ages was fairly efficient, taking into consideration the difficulties of communication in those days, but declined in course of time, and was finally abolished by the French Revolution, which went so far as to forbid the assemblage of citizens of the same calling. The politicians of the Revolution held it to be the duty of the State to suppress the formation of all corporations with private interests not shared by the people in general.

Shortly after the grave commercial crisis which occurred in Germany during the years following immediately upon the Franco-German War, the Trusts were again revived, at first principally in the coal, salt, chemical, petroleum, sugar, and spirit branches. At the beginning of 1902 Germany possessed about 389, of which about 300 were organised by manufacturers and the remaining 80 by dealers. Since then the total number has risen to 400, of which the chemical industries contribute proportionately the largest number. At the present moment negotiations are taking place in Germany for the formation of a Central European Electrical Trust, and in spite of the many obstacles to be overcome, it is most probable that its appearance is only a question of time.

From many quarters public opinion has appealed to the State to take action with regard to the Trusts, but as yet no suitable or practicable proposals have been formulated. The annual congress of German lawyers discussed the question this year, and proposed that the Trusts should be compelled to give any information regarding their transactions to the Government, if such were deemed necessary, in the general interests of the nation. Dr. Steinbach, formerly Austrian Minister of Finances, seems also to advocate the intervention of the State for the prevention of the abuses called into being by Trusts, and proposes that they should be compelled to furnish exact details of all their transactions to the State Administration. He is also of opinion that the Government should, further, be empowered in the public interest to demand the alteration of any obnoxious rules in the organisation of the Trusts, and in case of necessity to abolish certain Trusts altogether.

In some cases the exaggerated demands of some Trusts has led to the formation of opposition Trusts. For example, the beetroot cultivators formed a Trust to protect themselves against the sugar manufacturers. Some of the Rhenish ironworks combined together and acquired coal mines in order to procure fuel at a lower rate. The Association of German Publishers intends to establish works for the manufacture of printing paper, in order to render itself independent of the paper market. The formation of these opposition Trusts is, however, fraught with a certain element of danger, as they undergo the risk of being undersold by the older and more experienced organisation.

In the meanwhile the principal German Trusts are taking steps to form a combination of all the Trusts in the empire, which is, for the present, to be affiliated to the Association of German Manufacturers. To this end, a meeting was held at Berlin, in April, 1902, and a commission appointed, which has already invited all the Trusts in Germany to take combined action. The first step of the Trusts' Association will probably be to influence any State legislation which it may deem inimical to its interests.—British Consul Frederick Rae in *Mining Journal*.

THE DIAMOND INDUSTRY.

The Amsterdam Chamber of Commerce, in its voluminous and locally valuable annual report (printed in English), reviews the diamond industry—an important one in the Dutch city. Unfortunately the report is somewhat belated, relating mainly to the year 1901, but some particulars are interesting. It mentions, for instance, the change effected in the diamond workers' trade by the application of the mechanical cutting or sawing process to the rough diamonds. Several parts of the stone, which were cut off gradually or ground away according to the old method, are now sawn to any desired size from the rough stone and converted into small brilliants. "The advantage of this proceeding is so obvious," says the report, "that it will require no further explanation. The London syndicate immediately availed themselves of this new invention, by raising the price of all stones fit for the operation of the mechanical saw. This resulted, as usual now and then, in temporary obstruction to the trade." The report goes on to say that "one of the causes for slackness of trade in ground diamonds was the fact that since the prices have become 100 per cent. higher in the course of two years, the speculative trade in the article has entirely subsided and the sale is limited to replenishing of stock." A source of much disquiet in the market was the selling of great

quantities of polished diamonds at low rates. This would have produced a panic in 1901 had not the market "been supported by a stern confidence in the London rough syndicate." In 1902 it transpired "that those sales below the market value emerged from some untrustworthy merchants and agents." It appears that for some years there has been a decline in the diamond working industry in Europe. The report, whilst describing the unfavourable state of affairs in Amsterdam, says circumstances were last year just as bad in other places. "In Hanau, St. Claude and environs, Geneva, London, &c., are fewer men at work than a few years ago. The Hanau manufacturers are trying to obtain an import duty of 25 per cent. *ad valorem* on polished diamonds as a means to improve their business. In this sense they have sent a petition to the German Government. But the jewellers strongly oppose their movement. New York alone makes an exception. There the work is carried on pretty regularly, without showing any retrogression. The United States are still the principal buyers of our product."—*The Times*.

ST. LOUIS EXHIBITION, 1904.

The United States Mint is striking special souvenir gold dollars to commemorate the centenary of the purchase of Louisiana from the French in 1803, and as a souvenir of the Universal Exposition, St. Louis, 1904. By Act of Congress, the issue is limited to 250,000. The face of the coin bears the lettering "Louisiana Purchase Exposition, 1803-1903, One Dollar," whilst, on the reverse of half the number, is impressed the head of Thomas Jefferson, the statesman who negociated the treaty with Napoleon for the purchase. On the remaining 125,000 is the head of William McKinley, among whose last official acts as President was the signing of the proclamation of the Exhibition. Around the portraits are the words "United States of America." The first 50,000 dollars, 25,000 of each design, are ready and will be offered for subscription through bankers and banking houses at three dollars each, none to be sold at a lower figure. The first coin struck was for President Roosevelt; the second has been handed to Mr. Shaw, the Secretary of the Treasury. Some estimate of the sale value of this small issue of souvenir coins can be formed from the present price of the ordinary United States gold dollars, which, if at all in condition, readily fetch two dollars each, while, if they belong to the smaller issues, they command as much as twenty-five or fifty dollars.

The first gold dollars were issued in 1849. Between 1849-1890, 19,499,337 coins were struck. Up to 1858, 16,762,701 dollars were made—an average of 2,000 a year. In 1853, 4,384,149 coins passed between the dies. The smallest issue in any one year was in 1875, when the total reached only 420. The present issue of gold of this denomination is the first since 1889. The profits accruing from the St. Louis coins are to be devoted to the erection on the Exhibition grounds of two heroic statues of Thomas Jefferson and William McKinley. The offices of the St. Louis Exhibition for the United Kingdom are at Sanctuary House, Tothill-street, Westminster, S.W.

Correspondence.

METHODS OF MOSAIC CONSTRUCTION.

I am at present engaged upon the production of cartoons and the filling in of incised monumental work at Harrow-on-the-Hill. In the first case I had no difficulty, the motif from my design having been produced in faïence by Theodore Deck, of Sèvres though the faïence was in a much brighter key than the mosaic.

The obstacle that I have had to encounter is the use of silver to find graduation of tone in so bright a substance; aluminium does not tarnish, but then it fuses at a low temperature, as does also lead. Thus I think that I shall have to use tin.

I think it not at all unlikely that at Pompeii linen was used for the tesseræ, as it answers all the purposes of paper.

JOHN LEIGHTON.

THE ETYMOLOGY OF "BOOKS," ET CÆTERA.

In my remarks in the discussion on Mr. Douglas Cockerell's paper on Technical Education in connection with the Book-producing trade, I ventured on an etymological digression in illustration of the origins of the prevailing present form of books. As this point may prove suggestive to future students of the subject, I now submit what I then said with some further etymological particulars.

We may pass by writings [cuneiform] on bricks, and on rocks.—although it is interesting to note by the way the passage in "the Book of Job," xix., 23, 24, referring explicitly to the latter:—"Oh that my words were now written! That they were inscribed in a book! That with an iron pen and lead they were graven in the rock for ever!" Possibly as ancient was the use of writing on strips from the stem of the Nilotic sedge the Egyptians called by a name which in the mouths of the Greeks and Romans became "papyrus," and in ours, "paper." The actual portion of the pellicle of this sedge used for writing, the Egyptians called by a name which in the mouths of the Greeks became *byblos*, and *biblos*, specifically "a book," and *biblion*, "a little book"; in Latin "biblia," meaning collected "writings," whence

was directly derived the French and English "Bible." Another Egyptian name for the pellicle became the Greek word *chartés*, whence our words "chart," "card," &c. The Greeks also called the separate strips of the papyrus *selis*, a "leaf," [cf. Greek *lepein* "to scale"], which gummed together formed what we call a "page,"—this word coming to us through the Latin "pagina," ["pangere," to fasten], from the Greek *pégnuein*, "to make fast," *pégma*, a "bookcase," &c. [cf: "pact," "peace," &c., and Sanskrit *pacas*, "a band," Zend *pacaiti*, "bonds," *pacu*, "cattle"; and again Latin "pecus" "cattle," "pecunia" "money," &c.] The Romans called this pellicle "liber," *i.e.*, "bark," whence our word "library." But the book formed of strips of papyrus was not of the form with which we are now familiar, but a roll, generally single but often double, called by the Greeks *kylindros*, and by the Romans "volumen" [from "volvere" cf: Russian *valih*, "a cylinder," Sanskrit, *valayata*, "sets rolling," and our "worm," "whelm," "wallow," "whelm," "wile," "willow," &c.], the term now wrongly applied by us to a separate section of one of our cuboid books. What we erroneously call a volume the Greeks called *tomos* [cf: "anatomy," "tonsure," &c., and again the Greek *temenos*, and Latin "temenum" or "templum," a "temple"] *i.e.*, a "section" of a work of several "cylinders" or "rolls," the *tome* of the more accurate French. When about the 7th century parchment [from Pergamon] entirely superseded the use of papyrus, it was rolled up in the same way; and writings on parchment continued to be rolled up in this way long after the introduction of the separated "leaf" form of book; and, indeed, the use of "rolls," in the case of manuscript records, and legal documents, continues to this day. The modern form of the book has probably two origins. Ancient writings were not only on rocks, bricks, sheets of lead, or copper, papyrus, skins, but on planks or tablets of wood, as in China to this day [compare also the *pata* of the Hindus]. These tablets were cut from the trunk of a tree, called in Latin "codex," *i.e.*, "caudex;" a term the Romans applied to "account books," "recipe books," "law books," and books generally; the "codex" * or, as we say, code, not having its leaves joined together, and *rolled* up from one end or both, as were those in the "volume," but arranged separately, as in the modern book. Two planks of wood, or two tablets of wood, ivory, or metal, hinged together, received, both among the Greeks and Romans, the name of *diptycha*, and the written [with style on wax] diptych was the first separately leaved book of our type. When the word "book" first took the place of such words as "volume," and "code," is not known. But it has now been made clear that it is the Saxon word *boc*; and it refers to the beech tree, the inner bark of which [*bhoja-patra*] is still used for writing in Thibet, Lahoul, and other of the sub-Himalayan States.* The use of it for this purpose in India must be very ancient, for it is explicitly mentioned in one of the dramas of Kalidasa [? 6th century, A.D.]. Like the palm leaves used in Southern India, the strips of *bhoja-patra* are not gummed together, and rolled up, but are laid separately one over the other, in ordered pages, the whole being bound between two thin boards, held together either by a wrapper of cotton or other cloth, or a turn or two of tape or twine, or by a peg, or sometimes a wide, gaping ring, on which the leaves were, one by one, turned away from the reader as he completes their perusal. Possibly the collected writings of the Saxons were preserved in a similar form. It would be handier than the Roman "codex," and this may serve to explain the supersession throughout the Teutonic countries of Europe of the Roman word "codex" by the Saxon word "book." The great evolution throughout Europe in the production of collected writings as books was due, not so much to the invention of printing, ["Speculum Humanae Salvationis," 1438; in China block printing, 6th cent.; moveable types, 10th cent.], as to the invention [early 14th cent.: in China, of cotton, 6th cent.] of linen paper, which in the binding naturally took, not the form of the "volume," but of the "code," with the Saxon name of "book."

GEORGE BIRDWOOD.

* The "codicillus" was a diminutive tablet for writing memoranda. Cf: "libellus" and "cartula."

* This bark has various uses, and is regarded as sacred all over India. The jars of Ganges water, brought to this country by the illustrious Maharaja of Jepore, were covered over with it; and it should be thrown also into every funeral pyre of a twice-born Hindu.

Obituary.

FIELD-MARSHAL SIR JOHN LINTORN SIMMONS, G.C.B., G.C.M.G.—Sir John Lintorn Arabin Simmons died at his residence, Hawley-house, Blackwater, Hants, on Saturday morning, 14th inst. He was born at Langford, Somersetshire, February 12, 1821, and after being educated at Elizabeth College, Guernsey, and at the Royal Military Academy, Woolwich, he obtained his first commission as a second Lieutenant, Royal Engineers, in December, 1837. His early service was in North America, and for the first portion of his professional career he devoted his attention largely to railway work, holding successively the appointment of Inspector of Railways; Secretary to the Railway Commission, and Secretary to the Railway Department of the Board of Trade. From 1854 to 1856 he was H.M.'s Commissioner with the Ottoman Army, and subsequently he took part in the siege of Sebastopol. From 1857 to 1865 he was Consul-General at Warsaw, and in the latter year he commanded the Royal Engineers at Aldershot. From 1865 to 1868 he was

Director of Military Engineers, Chatham, and in 1871 he published a pamphlet on "The Military Forces of Great Britain," which is specially referred to in the Obituary notice of the late Field-Marshal in *The Times*. From 1870 to 1875 he was Governor of the Royal Military Academy, Woolwich; Inspector-General of Fortifications from 1875 to 1880, and Governor of Malta from 1884 to 1888. Sir John Lintorn Simmons attained the rank of Field-Marshal in 1890. He was one of the senior members of the Society of Arts, having been elected so far back as the year 1853.

Notes on Books.

ACROSS ICELAND. By W. Bissiker. London: Edwin Arnold. 1902.

In the summer of 1900, Mr. Bissiker and a party of friends crossed Iceland from the north-east to the south-west, traversing the comparatively little known volcanic region of the island. The present volume gives an account of the trip and of the country crossed. The information given will be very serviceable to any who contemplate a like excursion, which, according to Mr. Bissiker's account, can be made without much difficulty, and in a reasonable amount of time, if suitable preparations are made beforehand. The book is illustrated with a number of excellent photographs, taken by the author and his friends, and can be recommended to those interested in Iceland, or desiring information about it.

ALBRECHT DÜRER. By Lina Eckenstein. London: Duckworth and Co.

FREDERICK WALKER. By Clementina Black. London: Duckworth and Co.

These are two additional volumes of the series of little books on great artists, published by Messrs. Duckworth; previous volumes of which series have already been noticed. The subjects of these two books illustrate the wide extent of ground covered in the several volumes from the 15th to the 19th centuries. These monographs are fully illustrated.

General Notes.

DIPLOMA DESIGN FOR THE UNIVERSITY OF LONDON.—The University of London offers a prize of five guineas to the students of the Art Schools of London and others, for an original design for degree diplomas granted by the University to internal students. The design should be simple and dignified in character, and should depend in the main for its artistic effect upon the lettering employed, and the arrangement of type and spacing. Complementary design upon the diploma, though it must be simple in style and suitable for a university document, is not strictly excluded; nor, subject to the conditions stated, are designs employing colour. Competitors may insert the arms of the University, or omit them, as seems most congruous with the design as a whole. Room for the seal of the University, measuring 2½ inches in diameter, is to be left. Designs must be sent in to the Academic Registrar, University of London, S.W., from whom further particulars can be obtained, on or before April 1st, 1903.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock:—

FEBRUARY 25.—"Tonkin, Yunnan and Burma." By FRED. W. CAREY, late H.B.M.'s Acting-Consul at Szemao, China.

MARCH 4.—"Education in Holland." By J. C. MEDD.

MARCH 11.—"Existing Laws, By-laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions." By T. BRICE PHILLIPS. (Fothergill Prize Essay.) SIR WILLIAM H. PREECE, K.C.B., F.R.S., will preside.

Dates to be hereafter announced:—

"Oil Lighting by Incandescence." By ARTHUR KITSON.

"The Use of Electrical Energy in Workshops and Factories." By ALFRED C. EBORALL, M.I.E.E.

"Modern Bee-Keeping." By WALTER FRANCIS REID, F.C.S.

"Preservation of the Species of Big Game in Africa." By E. NORTH BUXTON.

"Fencing as an Art and an Historic Sport." By EGERTON CASTLE, M.A.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock:—

FEBRUARY 26.—"Gleanings from the Indian Census." By JERVOISE ATHELSTANE BAINES, C.S.I. SIR ROBERT G. C. MOWBRAY, Bart., M.P., will preside.

MARCH 12.—"The Currency Policy of India." By J. BARR ROBERTSON. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

APRIL 23.—"The Province of Sind." By HERBERT MILLS BIRDWOOD, C.S.I., M.A., LL.D.

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 or 5 o'clock:—

MARCH 3, at 4.30 p.m.—"The Uganda of To-day." By HERBERT SAMUEL, M.P. SIR HARRY H. JOHNSTON, G.C.M.G., K.C.B., will preside.

MARCH 31, at 4.30 p.m.—"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo.

MAY 5, at 4.30 p m.—"The Lagos Hinterland: its People and its Products." By MAJOR J. H. EWART.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock.

MARCH 17. 4.30 p.m.—"Artistic Fans." By MISS HANNAH FALCKE. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

JULIUS HÜBNER, "Paper Manufacture." Four Lectures.

LECTURE IV.—FEBRUARY 23.—Single cylinder and other types of paper-making machines—Finishing — Cutting—Statistics—Paper-testing—Experimental paper making.

PROF. J. A. FLEMING, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." Four Lectures.

LECTURE I.—MARCH 2.—*General Principles. The Theory of the Radiator or Aerial.*—Introductory remarks—The production of an electric wave—The theory of the aerial or radiator—Comparison between organ pipes and Hertzian wave radiators—The propagation of an electric wave over earth or water surface —Fundamental and harmonic electrical oscillations in radiators—The Marconi radiator—The Braun radiator —The Slaby radiator—Oscillation transformers and multiplicators.

LECTURE II.—MARCH 9.—*Transmitting Arrangements and Transmitters.*—The various elements in a Hertzian wave transmitter—The induction coil—Various forms of coil—Various forms of break—Alternating current transformers—The primary circuit interruptor—The discharger and condensers—The simple radiator—Marconi's syntonic radiator—Braun's inductive system—Multiple transformation system—Production of powerful æther waves.

LECTURE III.—MARCH 16.—*Receiving Arrangements and Receivers.*—The function of the receiving aerial — Electric wave detectors or responders — Classification of responders—Hughes's metallic microphone—Branly-Lodge coherer—Marconi receiver—Anticoherers—Magnetic receivers—Marconi's magnetic receiver—Thermal and electrolytic responders—Various forms of receiving arrangement.

LECTURE IV.—MARCH 23.—*Syntonization and possible Improvements.*—The problem of syntony—Time period of an electric circuit—Syntonic arrangements of Lodge, Marconi, Slaby, and others—The difficulties of the problem—Suggested substitute for syntony—Arrangements of Blondel and Anders Bull —Problems awaiting solution—The limitations and utilities of Hertzian wave telegraphy—The future of the new telegraphy.

W. WORBY BEAUMONT, Mem.Inst.C.E., "Mechanical Road Carriages." Four Lectures. April 27, May 4, 11, 18.

MEETING FOR THE ENSUING WEEK.

MONDAY, FEB. 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Julius Hübner, "Paper Manufacture." (Lecture IV.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. Henry Lovegrove, "Regulations for Protection from Fire."

Geographical, Burlington-gardens, W., 8½ p.m.

Actuaries, Staples-inn Hall, Holborn, 5 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. T. Hepworth, "Some Curiosities of the X-rays."

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, FEB. 24...Royal Institution, Albemarle-street, W., 5 p.m. Sir William Abney, "Recent Advances in Photographic Science." (Lecture I.)

Hellenic Studies, 22, Albemarle-street, W., 5 p.m.

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. George Frederick Zimmer, "Mechanical Handling of Material."

Photographic, 66, Russell-square, W.C., 8 p.m.

Anthropological, 3, Hanover-square, W., 8½ p.m,

WEDNESDAY, FEB. 25...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Fred. W. Carey, "Tonkin, Yunnan and Burma."

Geological, Burlington-house, W., 3 p.m.

British Astronomical, Sion College, Victoria-embankment. E.C., 5 p.m.

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

THURSDAY, FEB. 26...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. Jervoise Athelstane Baines, "Gleanings from the Indian Census."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "Insect Contrivances." (Lecture I.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. J. Stöttner, "The Nernst Lamp." 2. Messrs. A. D. Constable and E. Fawssett, "Distribution Losses in Electric Supply Systems." 3. Mr. M. Field, "A Study of the Phenomenon of Resonance in Electric Circuit by the aid of Oscillograms."

Camera Club, Charing-cross-road, W,C., 8½ p.m. Mr. Carmichael Thomas, "Odds and Ends from an Editor's Portfolio."

FRIDAY, FEB. 27...Royal Institution, Albemarle-street, W., 5 p.m. Weekly Meeting, 9 p.m. Prof. Adolph Liebmann, "Perfumes: Natural and Artificial."

Civil Engineers, 25, Great George-street, S.W., 8 p m. (Students' Meeting.) Mr. E. Falk, "The relative advantages of Single Screws, Twin Screws, and Triple Screws, for Marine Propulsion."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

SATURDAY, FEB. 28...Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "Light: its Origin and Nature." (Lecture I.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

MONDAY, MARCH 2, 8 p.m. (Cantor Lectures.) PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." (Lecture I.)

TUESDAY, MARCH 3, 4.30 p.m. (Colonial Section.) HERBERT SAMUEL, M.P., "The Uganda of To-day."

WEDNESDAY, MARCH 4, 8 p.m. (Ordinary Meeting.) J. C. MEDD, "Education in Holland."

Further details of the Society's meetings will be found at the end of this number.

FIRE PREVENTION PRIZES.

The Council of the Society of Arts, at the request of the Executive Committee of the International Fire Prevention Exhibition, have decided to offer, out of the funds of the Fothergill Trust, the following prizes at the Exhibition which is to be held at Earl's Court during the current year :—

For the best chemical fire engines for town use shown at the Exhibition :—One gold medal, two silver medals, and two bronze medals.

For the most easily worked long ladders, to reach the sill of a window 80 feet above the level of the pavement, which shall also be capable of being rapidly transported over roads of not more than 25 feet wide, shown at the Exhibition :—One gold medal, two silver medals, and two bronze medals.

The medals will be awarded by the Council on the report of the judges appointed by the Executive of the Exhibition.

The Council reserve the right of withholding any of the medals, or of awarding medals of lesser value, if in their opinion the exhibits should not be deserving of any, or all, of the medals offered.

CANTOR LECTURES.

On Monday evening, 23rd inst., Mr. JULIUS HÜBNER delivered the fourth and concluding lecture of his course on "Paper Manufacture."

A vote of thanks to the lecturer for his course of lectures was passed on the motion of the CHAIRMAN.

The Lectures will be printed in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, February 26, 1903; SIR ROBERT J. C. MOWBRAY, Bart., M.P., in the chair. The paper read was "Gleanings from the Indian Census." By JERVOISE ATHELSTANE BAINES, C.S.I.

The paper and report of the discussion will be published in next week's number of the *Journal.*

Proceedings of the Society.

APPLIED ART SECTION.

On Tuesday evening, February 17, 1903; LEWIS FOREMAN DAY, Vice-President of the Society, in the chair.

The paper read was—

HERALDRY IN DECORATION.

By GEORGE W. EVE.

The choice of heraldry in decoration as a subject on which to offer suggestions to the Applied Art Section of the Society of Arts is influenced (apart from the necessity of limiting in some measure the scope of heraldic art in general) by the consideration that, as it was in decoration that heraldry found admirable expression from a very early period, its decorative use in the past is now worth study with a view to the satisfactory execution of modern work.

Primarily heraldry, no doubt, consisted of the devices which distinguished leaders in the field, but its close connection with the personality of its bearer, whom it represented in a very intimate way, also led to its use in every conceivable form of decoration. In costume, ornament, and furniture, as well as in the hangings of tapestry and in other mural adornments, it became a striking and universal feature of the art work of its time. Owing to this strong personal and allusive quality, the employment of heraldic motives in the decoration of buildings has continued, even down to our own time, to show a more marked degree of excellence than was for a long period present in other forms of heraldic expression.

Decorative work was also the direction in which the revival of heraldry, which accompanied the Gothic revival, first showed itself. Perhaps the inherent difficulties of the materials may have suggested the sincerity of the effort to properly employ them.

It will not be necessary (even if time allowed) to go very far into the origin of heraldry. For our purpose it began about the 11th century—that is to say, it began to be used and systematised, more or less, as we know it, but in its essence it must always have existed.

The desire to distinguish himself by some visible means seems to have characterised man ever since we know anything about him. Badges are mentioned as the ornaments of kings and chiefs from the earliest historic times, from that of the Chaldean King, 4000 B.C., onwards. Some of these early personal devices were strangely similar to those with which we are familiar in later times. The figures on the sculptures at Persepolis, for example, have veritable crests on their heads, and these also occur on the heads of the king and his heir apparent in contemporary coins. There may even have been some sort of regulations controlling the use of the various devices, but we may at least be sure that the powers that were took good care that others did not use their badges if they could help it.

Artistically, our heraldry from its rise in the 11th century quickly developed a high standard of decorative excellence, flourishing exceedingly, with certain changes of style and method, for three hundred years until the middle of the 16th century, when its period of greatest strength and beauty ended, and its decadence began. As a system it seems to have developed in a natural way on the lines of its own necessities, as did its artistic expression in a great measure, but the latter owed much to previous design, and, mainly through the influence of the textiles and other importations (sometimes brought by returning crusaders), helped to perpetuate in the Western world the lions, eagles, and strange and characteristic composite animals of the East. These ancient prototypes of heraldic forms are singularly interesting, and concern us here because they sometimes possess in a marked degree qualities which teach valuable lessons that are applicable to present use. This will be discussed presently.

Although at first the mediæval draughtsman followed the drawing of his imported or traditional motives with considerable closeness (as in the lions of one of the 13th century MSS. in the British Museum), he soon began to treat them in the way that came to be considered peculiarly heraldic. In thus handling his motives he was entirely himself, and the outcome was the natural result of that splendid sense of design which distinguished him. The style is rightly considered purely heraldic, because it arose from its own heraldic conditions, and was the result of the very sane intention that the thing done should be suited to the use to which it was to be put, viz., to serve as a distinctive badge, which could be seen and easily read at a distance, and, in many cases, when in motion. To this end the object was drawn as large as the containing space would fairly admit, and its form was attenuated so as to allow the ground colour to show through in due proportion, and so effect clearness of definition. Vigorous draughtsmanship also contributed to the splendidly decorative effect that was due to good distribution, and the fine balance of colour that results from it. Thus the treatment which was suggested by reasons of practical convenience, resulted in an effect of great decorative value which also afforded opportunity for the use of expressive line. It is interesting to contrast this treatment with that of the later renaissance, such as the naturalistic lion by Della Robbia, which would have become an undistinguishable blob at a distance at which the attenuated form would have been quite effective. In a similar way an eagle drawn in the ancient way, with the wing-feathers strongly divided, was at once more distinct and more decorative than its renaissance successor.

Another practical consideration, the need of readily repairing the damage caused in action to the actual shield, dictated the flat and simple treatment of much of the painted decoration. A similar simplicity occurs in

some of the MSS., especially in such as are of large extent or of frequent repetition when economy of time and labour was desired. When, however, circumstances allowed, time and skill were not spared in the elaboration of the work. It is of course for this reason that the heraldry in architectural decoration is generally found to be among the best work of its period.

In the ceremonial shields, this elaboration is very great. They were made of layers of various materials, such as canvas, stretched on wooden frames, and the changes were then modelled in gesso, and afterwards gilt and painted, or were fashioned in stamped leather and pinned down to the surface. The spaces were diversified with the beautiful tracery known as diapering, and the whole result was rich and beautiful in the extreme. Large numbers of these shields were made in Italy down to a late period. A most admirable English example is the shield at Canterbury Cathedral, said to be that of the Black Prince. Here the lions are admirably distributed, full of power and life, and less extravagantly drawn than those of John of Eltham at Westminster Abbey, but they lack something of leonine character. The *fleur de lis* of France are beautifully free and graceful, and though so dissimilar in shape to the lions, are equally well designed to occupy their spaces and equally well proportioned to them. The whole work, which is so excellent an example now of some of the best qualities of heraldic design, has suffered from the wear of the centuries, but when it was uninjured must have been superb. The lack of leonine character in the lions might naturally be expected when it is remembered that they were the descendants of generations of copies and, therefore, were not consciously generalised from objects seen by the artist. Even when he did see a lion his acquired ideas were too strong for him, so that one in a 13th century book of sketches, though noted in the margin as "drawn from the quick," is very like its patternlike fellows.

Whether the treatment was simple or elaborate, however, its breadth of effect and decorative quality were nearly always conspicuous. These various methods, both satisfactory in their way, are of special interest to those who require historic sanction to a choice of treatment, in opposition to the opinion that, as certain methods of work, or works of a certain period are good, they are, in addition, perfect and everything else is wrong. So, when a flat treatment, in harmony or contrast with surrounding decoration seems desirable, the armorials may be done flatly, and when on the other hand a more elaborate treatment seems fit, modelling in relief or any other suitable means of decorative effect may be employed. The old work itself, full of variety and freedom, teaches us how to look at the subject without pedantry, but not without knowledge. It teaches the right of individual treatment combined with selection, and illustrates in a measure the essentially artistic principles taught to Kipling's primæval ballad-maker by his totem,

> "There are nine and sixty ways of composing tribal lays,
> And every single one of them is right."

It is not meant, however, that ignorant and reckless scribbling is right. Order as well as freedom is necessary, and this can only be secured by a study of the subject from all points of view.

The early treatment of the crest, helm, and mantling will also amply repay study. Being made of light material, and having its weight, which was still considerable, supported by the shoulders on which the helm rested, the crest was of conspicuous size and is so represented. In early times it is said to have been one of the privileges of knighthood, and this would additionally explain its emphasis. The helm was usually that known as the great helm, to distinguish it from the helmet, basinet or other form of head armour. The latter, having a visor or front which opened, and a movable neck, came into use in the 15th century to meet the desire for lightness and mobility in actual battle, and thenceforward crests and the great helms that bore them were reserved for the tournament and other military solemnities. There was another especially practical reason for this disuse. It had been found that a crest was a dangerous ornament in actual battle, for at close quarters it served as an excellent handle by which to pull down the wearer's head. King Stephen is said to have been taken prisoner in this manner. The mantling, which was at first quite simple, soon became of the greatest value as an element of composition, and the importance of its free possibilities of line was quickly recognised. From a mere representation of the helm drapery, it thenceforth developed through various forms until it became in many instances similar to the contemporary architectural tracery, when, as in the 15th century carvings, it surrounded the shield and ornamented the surface of the panel in a very complete and beautiful way.

By the Tudor time heraldry had ceased to be

used in war in the old way, with such exceptions as banners and the decorative and emblematic shields on ships of war, and it, of course, remained an essential part of the tournaments, while they continued to exist, but heraldry in the main became merely decorative thenceforward, retaining, of course, its allusive and symbolic qualities. In this way it greatly increased, thus sharing in the impetus given to the arts by the end of the Wars of the Roses. At this time a remarkable number of simple flowers came into heraldic use, columbine, gillyflowers, marigolds, honeysuckle, and many more appearing not only as arms but in garlands as decorative accessories.

By this time also the shield shapes had become less simple, following in their cuspings the fluted armour of which they formed part, and others of which large numbers were designed by the little masters were frank applications of the decorative scrolls of the time. The concave shield whose raised edges took the light and helped to define the form, while assisting, together with the shadow within it, the distribution of light and shade, became much in use.

Some of the early renaissance heraldry retained much of the excellence of the preceding Gothic as regards the pose of the figures and the general composition, and it attempted, in addition, the characterisation that was wanting in the earlier work. In many respects it was very admirable, and seems, in its individual thought working on some of the suggestions or traditions of the older style, to suggest the lines on which modern heraldry might develop. At the same time there was a more naturalistic school, of which the heraldry in Della Robbia's work may be taken as the expression, and this also is interesting, *but as a warning*. It most unfortunately overpowered the more decorative style, and ultimately developed into the feebleness which characterised the heraldry that preceded the revival in the last century.

A well-known example of the better renaissance is the plate by Albert Dürer, of a shield bearing a rampant lion. In this plate there is also evident a desire to render the mantling more cloth-like, though still complicated. Mantling afterwards followed the influence of the conventional leaf forms of the renaissance.

I have ventured to give you this slight sketch of the development of the artistic side of heraldry, not as a mere historic retrospect, but because it is in the study of old work that guidance is to be found for present requirements. But in this connection, a word of warning may perhaps be permitted against making a fetish of the work of any period, however good. Another is against mere copying of old examples however excellent, except, of course, for purposes of study. Merely to copy bits of heraldic precedent and to piece them together is not the way to make an artistic thing at all. A copy has no vitality of its own, and cannot even reproduce that of its original, for it is more than doubtful if it is possible to reproduce the spirit of work done under other conditions and modes of thought. Even Pugin, to whom the revival of decorative heraldry owes so much, with all his sympathy, and with all his powers of draughtsmanship, cannot be said to have altogether caught the intense vigour of his originals.

Again, hardly anything possesses, at the same time, all the good qualities that it might have, and we sometimes excuse the absence of one because of the supreme way in which another is expressed. In doing new work a broader view is necessary if it is to result in anything but a shadow of a former style. Heraldry should be expressive, interesting, and decorative. Original in treatment, and exhibiting the qualities that the best of the old work teaches us to desire, rather than being a copy of it. The term "original" here does not mean expression by means of wild arrangements of weird lines, which are perhaps original in the sense that there is nothing like them on earth, but rather the originality, or, perhaps I should say, individuality, which comes from serious attempts to express qualities rather than to copy styles.

The artistic expression of heraldry may be regarded in two ways; as a representation of an actual shield, crest, helm, and so forth, as they would be represented in a picture, of a tournament for instance, or as a presentation of the essential heraldic facts, in the way that is thought most expressive but without too much regard to preceding styles. The former seems more suitable to ancient and historic arms, and the latter to be more likely to harmonise with modern decorative surroundings, as well as to possess more vitality and variety in itself.

This harmony with surrounding decoration, is one of the essentials of design that should be continually kept in mind. Another condition, equally important, is suitability to the materials and methods by which the design is expressed. The two very obvious points cannot be too often insisted on, however wearisome the reiteration, for they are even now frequently ignored. One hears of shields

painted on vellum (with all the detail and finish to which that beautiful material lends itself), sent as a substitute for a working drawing for large embroidery or carving, and accompanied by instructions that they must be *strictly* followed. Or of friezes and panels, of which the different parts, heraldic and ornamental, have been done by different designers working in ignorance of each other's design. The general design is made, perhaps of well drawn and graceful lines, with spaces where it is thought, probably correctly, that the shields would tell. Then a sketch, perhaps a mere diagrammatic note of the arms, is procured, enlarged to the right size, and blindly copied. Of course the result is patchwork. Careless treatment of heraldry seems to pervade applied art, and so to spoil what is otherwise meritorious work. Much incongruity arises from fear lest improving the drawing or composition may violate heraldic rules, and this brings us to the necessity for acquiring such a knowledge of the subject as will enable the designer to know what points are really essential, and therefore to be carefully retained and accentuated where accent is proper, and what, on the other hand, may be modified or ignored. A knowledge of the system of heraldic description, called blazon, will be absolutely necessary to this end. Pedantry in non-essential matters is of course absurd, and artistic freedom is always to be desired, but there must first of all be a basis of knowledge on which to work.

It will be necessary to study the subject sufficiently to distinguish between the essential principles (such as underlaid the old good work) and the later amplifications of rules, full of pedantic insistence on regulating every detail however unimportant, which were made when the legal mode of thought had displaced the artistic one. The rules that are necessary to prevent confusion will be found sufficiently elastic to allow variety of treatment.

Among the qualities that it will be desired to express are just proportion, distinct definition, good distribution in filling spaces, strongly characterised and well accented forms, and vigorous pose.

The proportion of the parts of a usual form of heraldic group of shield, crest, helm and mantling, to each other remained fairly constant from the end of the 13th century to Tudor times, and may be taken (roughly) to be two-fifths of the whole height for the shield and three-fifths for the helmet and crest. This merely as a practical guide. I need hardly say that it is not to be taken as actual measurement, but only as suggesting the relative weights in the design. The character of the crest, whether broad and solid, or tall and slight, would affect this. The result of these proportions is to bring the helm a little above the actual centre of the design, where it forms a satisfactory point on which the other objects group themselves.

With regard to the proportions of ordinaries to their fields, many rules to be found in treatises may be safely ignored. In good work the ordinaries vary in size with the requirements of distinctness in respect to the other charges, and their variation in this way has no other significance. I do not, of course, deny the usefulness of points of proportion, they may be useful so long as it is recognised that they are approximate and variable guides instead of dogmatic inflexible rules. With regard to charges, it is equally impossible to say what exact proportion they should bear to the field, nor in most cases could we measure it if we did. It must be a matter of artistic perception which decides whether a space is properly filled. In any case the proportion would be an apparent rather than scientific one, and would be greatly modified by circumstances, colour for instance. I need hardly point out that the actual measurements would not be the same for a white object on black as for a black one on white. It is curious how prevalent the desire has always been to reduce to exact rules matters that are insusceptible of that kind of control. The 16th century efforts at a geometric way of drawing letters and the attempt to regulate minutely heraldic drawing are instances of a peculiarly wrongheaded way of approaching matters essentially æsthetic.

As to the animal forms, vigour is of the utmost importance, together with strong characterisation. In this connection the lions of the Assyrian reliefs are very suggestive. The expression of strong, leonine character by means of the accentuation of the muscular masses is a method that lends itself well to heraldic design. The composite figures are also well worthy of study in relation to the griffins and other monsters of later times. Gerard Leigh, writing in the middle of the 16th century, has something to say about griffins; they are, as you know, half eagle and half lion, which students of natural history may like to know, thus: "Griffins bear great enmity to man and horse; though the man be armed and on horseback, yet they take the one with the other quite from the ground and carry them clean away. I think they are of

great hugeness," he goes on "for I have a claw of one of their paws which should show them to be as big as two lyons." In another place Leigh refuses to believe something because "he had not seen the proof thereof."

It will be well to consider animal pose in relation to the anatomical possibilities, and the qualities of dignity, strength, or grace which are associated with certain charges should also find due expression.

The schemes of arrangement that suggest themselves as suitable to decorative purposes, are very various. Complete series of family arms and those of alliances, together with the honours conferred on individuals; arms of successive owners; shields marking the visits of distinguished guests, and so forth.

Unity of plan, such as when the arms are arranged in relation to some central object as the altar in a church or the fireplace in a room, for example, is, of course, desirable. In the latter case the central position would be appropriately occupied by the entire armorials.

The employment of Badges in decoration opens up a large and interesting field of design from their value as decoration in places where shields of arms are not so suitable. Though not subject to the same rules as the regular arms they were still regarded as of great though secondary importance, and became practically hereditary in many cases. Time, however, will not permit of their adequate treatment here. A kind of badge, more ephemeral in character, called an impress, was a fashion that came to us from Italy, as many other heraldric fashions did. They were devised from mere fancy, and consisted of a device with an explanatory motto. Henry VIII. and his knights at the Field of the Cloth of Gold bore a series of devices, of which they wore part each day until the whole was complete. Cosmo de Medici had a tortoise with a sail attached and the motto "Festina lente," and there were others innumerable. Like other heraldic matters, they sometimes led to quarrels. A knight who strutted up and down at the court of King James, had a falcon embroidered on his sleeve, and the motto, "I bear a raven, fearless in flight, who checks at him his death is dight." Then a Scottish knight saw the device, and after a while appeared with another. His was a raven with a piece of meat, and its motto said, "I bear a raven picking at a piece, who pecks at him, I'll peck at his nese." The story goes on, that in the arrangements for the consequent fight, the Scottish knight, who had but one eye, demanded that his opponent should lose one of his, in order to be on an equality.

There will not be time to do more than briefly allude to colour treatment. It will suffice to say that it is not at all desirable that heraldry should *scream* in mural decoration however necessary it may have been to do so in the field. So long as the tinctures are distinguishable with sufficient clearness any modification of tint may be used, and the colour may be broken by means of diaper or other surface treatment that may be desirable in order to make the heraldry take its appointed place. Always avoiding, however, any interference with the clear statement of the heraldric facts. The decoration may be modelled in gesso and treated with monochrome, so as to emphasize the modelling, or in many another way that practice will suggest.

The revival of the art of enamel also offers a splendid material for heraldic work. The series of works in enamel on the monuments, and above all, the early Stall Plates of the Knights of the Garter at Windsor, are too well known to need more than an allusion to the magnificent field of study they afford; but it may perhaps be permitted to hope that the beautiful art of enamelling which (though its revival is less than 20 years old) is fully capable of worthily following its long ago predecessors, may have, some day, an opportunity of doing so.

The value of heraldry in domestic decoration is also obvious. One can hardly imagine anything to excel the gemlike effect of armorial enamels on the dark panels of a library, for example.

Whatever be the material in which heraldry finds its means of expression, it is permitted confidently to hope that the wide and increasing interest that is being extended to the subject may result in the production of work that is not unworthy to follow the best of its predecessors.

DISCUSSION.

Mr. Charles Chadwyck-Healey, K.C., said that he had listened with great interest to Mr. Eve's remarks, and he wished to express his appreciation of the work that Mr. Eve had been doing for some time in developing the art of heraldry in this country. There was very great need for such work, for the country had been in a lamentable condition in this

matter for a great number of years, and it was so still, in spite of everything that had been done to bring about improvement. One need only to look, for instance, at the miserable way in which heraldry was impressed upon silver plate by the silversmith, by means of engraving. An instance came under his personal observation a year or two ago. It was desired to put a shield of arms upon a piece of old plate, and one of the leading silversmiths in London was invited to engrave it. A preliminary sketch was made, but a more pitiable thing was never turned out. The charges were reduced to the very smallest possible dimensions, so that they could hardly be recognised. The artist seemed to desire to display as much as possible the colour of the shield. The ordinary was also of the smallest dimensions. He hoped that the time was not very far distant when heraldry as a means of decoration might be developed, and that the practice of it would permeate through every class of artificer. But that could only be brought about by conscientious work, and by the example of men who had made the subject their study. He believed that a great deal was being done on the Continent in developing heraldry in design. Probably continental design would prove to be in the end rather more florid than English people cared to see, but, as an illustration of continental work he might refer to the Munich almanack, which was published every year, and which could be bought for a shilling. It was full of heraldic designs. The publication of a work of similar character was one of the ways in which heraldic design might be popularised in this country.

Mr. R. GARRAWAY RICE agreed that the subject was of great interest. It was noticeable how much better the earlier heraldry was than the later. If he understood Mr. Eve's work aright, it had gone on the principle of trying to bring back that simplicity which was true decoration, and to avoid excessive ornament. In the 18th century, when classical forms prevailed in architecture, heraldry, which was essentially mediæval, was out of place, and it was very difficult to introduce it, hence architecture and heraldry seemed to have fallen apart. At the present day one had the advantage of being able to study the various periods, but it seemed to him that the difficulty which a modern designer had to contend with was that having at his finger-ends practically everything that had gone before, it was extremely difficult to avoid a kind of mixture. The difficulty of modern artists was to give something pure and to avoid introducing features which were out of place.

Mr. R. PHILLIPS said that heraldry was a great aid in ornament, but no doubt those interested in the subject would agree that it had not retained the dignity and importance which properly belonged to it. He remembered in his wanderings in the New Forest coming upon a perfect mine of heraldry in the old Abbey Church at Christchurch. One point which had occurred to him, was the greater beauty of heraldic designs on buildings than in other things. He thought that the chief reason of this was, that in buildings, heraldic designs were always executed in higher relief.

Mr. GEORGE CLULOW said that Mr. Eve had put before them, in a very interesting way, examples of the decorative use of heraldic design in England and other countries, but had omitted Germany. He regretted this, because there were, in Germany, numerous examples of the 16th century which abounded in the vigorous and decorative character on which Mr. Eve had properly laid much stress. As to the way in which heraldry is often expressed on plate, they must look at the subject from the point of view of the ability of the person called in to do the work. The incident of which Mr. Chadwyck-Healey had told them, displayed, of course, great ignorance on the part of the designer and engraver. It seemed to him that attention ought to be called to the fact that there were among them gentlemen who were capable of supplying heraldry in scientific form, and according to the proper heraldic use. The value of a paper, such as had been read, was that it would call attention to that fact.

Mr. FRANK FREDERICK, in reply to the Chairman, said that the whole subject was absolutely new to him, as he came from a country where heraldry was not regarded, and where it was only seen in decoration and design. Only that day, in walking in the South Kensington Museum, he was struck with the fact that there was such a mine of wealth of design there.

Mr. ALEXANDER MILLAR said that he had derived extreme pleasure from Mr. Eve's book. That was a work which everyone interested in the subject ought to possess. But, like another speaker, he had been a little disappointed not to find more reference to German heraldry. He possessed a book of which an English edition was about to be published, which appeared to him to be the fullest and finest work on German heraldic design, so far as ancient examples were concerned. In that book, the crest appeared to be composed, in many cases, of enormous horns, taking a sort of lyre shape, and ending in a kind of trumpet mouth. He did not think that he had seen anything like it in English heraldry, though it was extremely common in Germany. He should like very much to ask whether Mr. Eve could explain what the purport of that design was. Reference had been made to a German almanack, which had been published for seven or eight years; something of the same kind appeared in this country this year and last year, and he had copies of it. This book gave the English coats of arms in precisely the same style that coats of arms were given in the German almanack, but the design was less extravagant, and had a more chastened method of expression. Mr. Eve referred in his book to the origin of the

fleur-de-lis, and he spoke of it as probably derived from the iris or the flag. He had the strongest possible belief that it was so derived, and he did not think that it could have been adopted from the lily, however much the lily might have been conventionalised.

The CHAIRMAN regretted that he was not so entirely in sympathy with heraldry as a chairman ought to be. He looked upon it rather as an art of the past, chiefly of antiquarian interest. The shield of arms borne by a man's ancestors in battle interested him; but not the arms granted in recent years to a civilian—what had he to do with a shield at all? He (the Chairman) was interested in heraldry mainly because it was decorative. He regarded it as the type of what symbolic design should be, and of treatment of such design. But symbolism itself might become tiresome; the "rathe primrose" had not gained in poetry since it became a badge of party politics. The decorator had much to learn from heraldry—especially as to readable expression, and as to the logical use of colour—a mercy to those who had not very acute colour sense. Another lesson to be learnt from heraldry was as to the treatment of animal form in decoration, and especially in ornament, by no means an easy matter. As to the Sicilian silks to which the reader of the paper had alluded, possibly the weavers learnt from the heralds, or each might have learnt from the other. What Mr. Eve had said about proportion in heraldry would be helpful to designers and practical decorators; and it would be encouraging to them to be told that they might treat heraldry very freely, so long as they used their common sense. The pedantry connected with heraldry was one reason why artists "fought shy" of it. And the persons who hampered the artist did not always know. He had himself been called to order for introducing a diaper of grass as a background to the crest of a mower—that was not his crest said the worthy gentleman. In the decoration of a façade of a railway station not a hundred miles from Snow-hill the arms of the counties through which the line passed were on shields of all shapes and periods, according to the notepaper heading or other such "authority" from which the sculptor worked—plainly, he was of opinion that the shape of the shield was a matter with which he had no right to tamper. The result was hopeless incongruity. Apropos of silversmith's work, he agreed with Mr. Chadwyck-Healey. Presumably it was on account of cheapness that silversmiths resorted so enormously to engraving as a means of heraldic expression. But if heraldry was worth introducing at all, it was worth treating in a more dignified manner, and should not be introduced in the shamefaced manner which was usual. The "Münchener Kalendar," he might mention, were designed by Otto Hupp, an artist imbued with the mediæval spirit. Mr. Eve had mentioned Pugin. He might have mentioned also Clement Heaton, who in his day did most vigorous heraldic work. Referring to an illustration shown by the author, the Chairman protested against angel shield-bearers—there was authority for it in old work; but we knew better, or ought to. To make an angel hold the shield even of a great "swell," seemed to him playing it rather "low down" on the angel. Why did not we have heraldry on our stamps? It would at least prevent the necessity of changing them with each new reign. After referring to Mr. Eve's own excellent work in heraldic design, the Chairman concluded by proposing a hearty vote of thanks to him for his excellent paper.

The proposal was carried unanimously.

Mr. EVE, in reply, thanked the meeting for the attention which had been given to him, and also thanked the various speakers for their interesting remarks. The reason that he had not dwelt on German heraldry, was that it was a large subject, and he could not include it within the limits alloted to him. He was a great admirer of German heraldry, and he regarded it as extremely fine and vigorous. As to the Munich almanac, of course they all knew it. He should have dwelt upon heraldic ornament in iron work, but through an accident, he was unable to have the slides ready. They would have been useful as showing how heraldic design should be adapted to the material used. He could not give any information as to the German horns, about which a question had been asked. He had always understood that the horns were due to early decoration of the helmet, and that the crest was a perpetuation and a derivation of them. He had referred to Pugin, as a representative name in the gothic revival. His son-in-law Powell, Burges, and West, among others, had also done admirable work. The Chairman had objected that heraldry was a thing of the past, and he assumed that all heraldry was of a battle origin. But that was not the case. In mediæval times, many people who never fought if they could help it used heraldic arms; and even if such arms were of battle origin, he did not see why civilians should dispense with the opportunity of using a personal emblem because they did not use it for fighting purposes. The silks which he had referred to were the early textiles which came from the East through Sicily, or were those copied from oriental examples. If the animals in those early silks were compared with the earliest illuminated manuscripts the resemblance would be found to be most marked. With regard to the mower, he sympathised with the Chairman in the circumstances he had described. He agreed that correctness of expression should be insisted upon. If a thing was written in heraldry it ought to be written in such a way that its meaning should not be misunderstood. The accuracy of the heraldic statement being thus safe-guarded, ts decorative treatment could then take the course that seemed fit.

TWELFTH ORDINARY MEETING.

Wednesday, February 25, 1903; Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Anderson, Sir R. Rowand, LL.D., F.R.S.E., 16, Rutland-square, Edinburgh.

Baker, Charles Edmund, 54, Parliament-street, S.W., and Park Hill-lodge, Shortlands, Kent.

Calderwood, James Macdonald, M.Am.I.M.E., M.Inst.M.M., Messrs. Symons and Moses, P O. Box 469, Johannesburg, Transvaal, South Africa.

Fraser, A. Brodie, Roddach Bow, Denton-road, Canton, Cardiff.

Grenfell, General Lord, G.C.B., G.C.M.G., The Palace, Valetta, Malta.

McLaughlin, Miss M. Louise, 2558, Eden-avenue, Mount Auburn, Cincinnati, Ohio, U.S.A.

Matland, George Read, 1, Finsbury-pavement, E.C.

Oelsner, Isidor, 31, Holland-villas-road, Kensington, W.

Quin, William James, J.P., Bishops Glen (P.O. Box 58), Bloemfontein, Orange River Colony, South Africa.

Rank, Joseph, Willersley-house, The Park, Hull.

The following candidates were balloted for and duly elected members of the Society: —

Ferguson, James, 4, Warltersville-road, Crouch-hill, N., and 91, Fore-street, E.C.

Hamilton, W. L. H., 16, St. Helens-place, E.C.

Hume, John, 18, Chapter-road, Willesden-green, N.W.

Lowry, George A., Board of Trade-buildings, Boston, Massachusetts, U.S.A.

Mackinlay, James W., Chumleigh, Finchley, N., and 85, London-wall, E.C.

Mossop, T., Bond-street-chambers, Bradford, Yorks.

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The paper read was—

TONKIN, YUNNAN, AND BURMA.

By Fred. W. Carey, F.R.G.S.
(Late H.B.M.'s Acting-Consul at Szemao, China.)

The title of my paper is somewhat of a misnomer. I could not hope to give you, in the time at my disposal this evening, a comprehensive description of Tonkin, Yunnan, and Burma. What I want to do is to treat, in a brief fashion, of these three countries in their relation to each other commercially; to describe two of the ways of penetration into South-West China; and to illustrate a journey from Haiphong up the Red River, through Yunnan and the Shan States into Burma. I trust that my illustrations will make up for any deficiency of matter in the paper itself.

Tonkin is the northern half of the kingdom, or empire of Annam, and was for many hundreds of years a tributary state of the Chinese empire. Little need be said of its history previous to the appearance of the French on the scene, towards the end of the 18th century. In 1799 they assisted their *protégé*, Ghia Lung, to the throne of Annam, but it was not until 50 years later that they began to take an interest in the government of that kingdom, an interest which did not cease until in 1885, as a result of the Franco-Chinese difficulty, Tonkin became a French colony.

Tonkin is divided naturally into two parts, the Delta, which is the low-lying and fertile southern portion, and the hilly country, commencing a little to the north of Hanoi, and extending north and east in both directions to the Chinese frontier. The mountainous portion is densely wooded, and very sparsely populated: minerals are said to exist in places. The Delta is simply one huge rice-plain, watered by the Red River and its numerous affluents. Generally speaking the climate of Tonkin is hot and unhealthy.

Haiphong, the principal port of Tonkin, is situated on the right bank of the CuaCam, one of the numerous mouths of the Red River, 12 miles from the sea. It is 48 hours from Hongkong by mail steamer. On account of the double bar at the entrance, the CuaCam is only navigable to steamers drawing less than 19 feet of water: and approach to the port of Haiphong is rendered still more difficult from the fact that the tides in the Gulf of Tonkin are diurnal, *i.e.*, there is only one rise and fall during 24 hours, instead of every 12 as on our own coasts.

The CuaCam at Haiphong is connected with the Red River by the "Canal des Bambous," a narrow waterway lying right through the middle of rice-fields. Communication with Hanoi is kept up by steamers of some 180 tons burden. Passage through the canal is very uninteresting, only one elevation, known as "Elephant Mountain," because that is the animal it least resembles, breaks the monotony of the plain. Around this hill the steamer seems to be constantly circling owing to the windings of the canal. There are a few villages near the banks and as the steamer passes bands of naked little boys—regular pirates in embryo—issue, and solicit alms as they run along, after the manner of the "have-a-dive" boys at Aden. Six hours passage through the canal brings the steamer out into the rapid waters of the Red River, and ten hours later the boat generally announces its arrival at Hanoi by running on a sand-bank. The Red River is of a most treacherous nature as regards the rapid formation of sand-shoals. During the rainy season (corresponding to the Indian monsoons) it is subject to rapid changes, rising from 16 to 18 feet in as many hours: so that what one day is a broad tract of dry sand covered with traffic becomes the next a wide expanse of clay-coloured water, on which float hundreds of bamboo houses; for the Annamese fisherfolk prepare themselves for such emergencies by constructing their dwellings on a raft-like principle, so that they buoy up as the river rises.

Hanoi lies on the right bank of the Red River, a fine bridge, completed only last year, connecting it with the opposite bank. It is now recognised as the official capital of Tonkin, although until a year or two ago Hué, the residence of the Emperor of Annam, bore that title. History records that Hanoi was founded in the 8th century by a Chinese Mandarin. Its original Chinese appellation (Tungking—"Capital of the East") is now perpetuated in the name of the country itself.

The European portion of the town of Hanoi is splendidly laid out. The public buildings and the Cathedral are very fine, and the lakes and open spaces about the town admirably kept. Altogether Hanoi is one of the brightest and most picturesque cities of the Far East.

At Hanoi we came into closer touch with the natives of the country, who belong to the common Indo-Chinese stock. The Annamese, both morally and physically, are one of the inferior races. The men are undersized, but active, good-tempered, and tractable. They have not the commercial instinct of their neighbours, and, as in Penang and Singapore, all trade is practically in the hands of Chinese merchants. The women have rather nice figures, and they would be considered good-looking but for their mouths, which are spoilt by the custom of covering the teeth with a layer of black lacquer. Their beauty is not enhanced, either, by the unpleasant habit of chewing betel. Equality of the sexes, so far as hard work is concerned, applies in Tonkin. We noticed many women employed in gangs, carrying timber for building, &c.

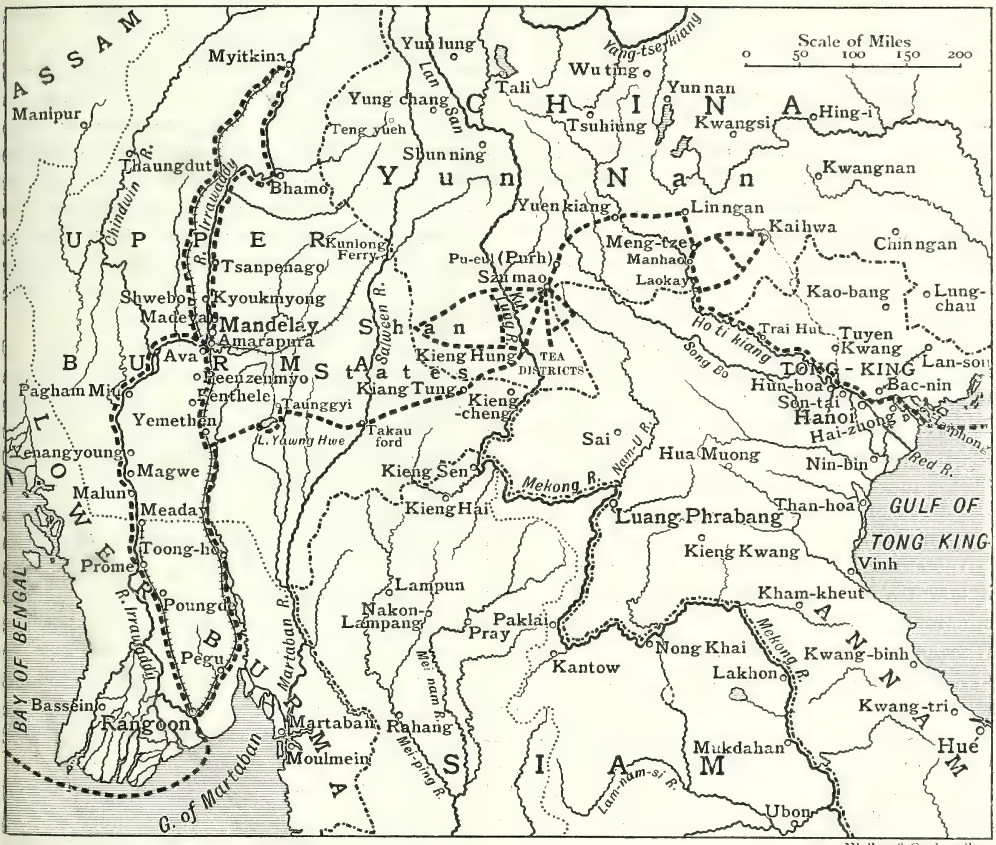
Hanoi is connected by railway with Langson, on the Kwangsi frontier. This line was a most costly one to the colony, and although it is intended to carry it on to Lungohow, and eventually to Nanning Fu on the West River, it is highly improbable that it will ever pay its working expenses. A railway to Viétri is also under construction, and will be carried on to Laokay in time. This is the line which is eventually to enter Yunnan, and I shall refer to it again in the course of my paper.

The steamer into which we changed at Hanoi, to continue our way up the Red River, belongs to the "Compagnie des Correspondances fluviales," who enjoy a monopoly of the river navigation in Tonkin. Our boat was a stern-wheeler, drawing five feet of water, yet able to run up as far as Yenbay, *only when the river is in flood*. We left Hanoi at noon. During the evening we passed Sontay (scene of a sanguinary battle between the French and Chinese in '85) on our left, and anchored soon afterwards for the night at Viétri, a small military post at the junction of the Clear and Red Rivers. The Clear River rises near Kaihua Fu in Yunnan, and has been suggested as an alternative route for a railway into that province. It is navigable for small steamers to Tu Yen-kwang, 40 miles or so up from Viétri.

During the forenoon of the next day we passed, on our left, the Black River, by far the most important tributary of the Red River. Steamers run regularly up to Chobo, but beyond that navigation is difficult and even dangerous at all times of the year, the river being very swift and rocky. Small narrow boats of half-ton capacity, carry goods during the dry season up to Laichow, near the Yunnan frontier; but when the river is in flood communication is impossible, and nothing is more dreary than life in some of the military posts on the Black River of Tonkin.

Three days out from Hanoi we reached Yenbay, a growing garrison town on the left

bank. There we changed into a small stern-wheel steamer of a newer type—the *Baoha* This boat runs between Yenbay and Laokay during the rainy season. Although only of light draught, and 40 tons burden, it cannot get up so far during the dry season. In fact the Red River is only navigable to small steamers, *all the year*, to Viétri. Native craft, on the contrary, are busiest when the river is low, and the current not quite so strong.



Walker & Cockerell sc.

MAP OF TONKIN, YUNNAN, AND BURMA.

Accommodation for passengers on board the *Baoha* was limited. There were twelve of us, and only one small cabin; and in this we had to eat, amuse ourselves during the day, and sleep—the settees being hooked up in sleeping-car fashion at night. Those who occupied the upper berths were comfortable enough; but those underneath suffered from the heat, and from fear of the dreadful consequences should the bars holding up the berth and the 200 lb. gentleman above give way.

The company is subsidized for military purposes by the Government, and every square inch of space outside the cabin was occupied by soldiers of the Foreign Legion. Most of these men were Alsatians or Norwegians; but at different posts on the way up I met three Englishmen, who gave me plausible reasons to account for their enlistment in the Legion,—the real one being, I suspect, a desire to keep as far away as possible from the Scotland Yard authorities.

The great feature, and at the same time the drawback, of the Red River are its numerous rapids, which add an element of danger to the difficulties of navigation. There are no less than sixteen of these places between Yenbay and Laokay, where the current rushes down over rocks with great velocity. The worst rapid is the "Ta Kai," just below the post of Traihut. As the little steamer forged its way slowly up against the strong current, the Annamese crew threw "joss-paper" overboard in handfuls to propitiate the river gods, and they attributed our safe passage to this sacrifice. We were at all events luckier than

the Commercial Mission sent out in 1896 by the French Chambers of Commerce to study the trade of Tonkin and China. They came to grief at the "Ta Kai," and had to continue their journey in junks. Perhaps the supply of "joss-paper" had given out!

The journey from Yenbay to Laokay usually occupies three days. Laokay is only a small place, but it is important as being the steamer terminus, and a frontier post. On the left bank the Tonkin-Yunnan frontier is marked by the NanHsi, a small stream which here joins the Red River, and Laokay is situated just at the junction. Chinese and French forts, perched on exactly opposite hills, stare defiance at each other across the little stream.

On the Chinese side of the NanHsi is the village of Hokow, where there is a branch of the Imperial Chinese Customs. Here we obtained the junks necessary for the continuance of our journey. The largest of these boats are 60 to 70 feet long by 9 wide, and have a carrying capacity of 12 tons; but those employed on the upper reaches can only take five tons weight of cargo. They all have the triangular mast peculiar to junks of the Red River. This mast is made of two long bamboos, attached one on each side of the boat, and fastened together at the top ends. It can be raised or lowered at will, and carries a big square sail.

We engaged three of the smaller kind, and having transferred our baggage into them, set sail in company with several other boats that were proceeding up river. There was a crew of five men to each boat. They did nothing but whistle whilst the wind lasted; when it slackened they would either jump ashore and tow us, or bring out long poles and push us along. When we arrived at a rapid (and these places are numerous between Laokay and Manhao) the crews of all the boats would combine to help each other over, and these were times of much hard work and fearful gesticulation. At critical moments recourse was had to the river gods, whose effigies are stuck up in rocky niches near the most dangerous rapids.

Proceeding up river from Laokay, we had Chinese territory on our right and French on our left, for the right bank is French up to the Lungpo stream, where the frontier turns at right angles and runs west.

About half-way up between Laokay and Manhao, on the left bank, is the small village of Hsinkai, from which place there is a road that runs by fairly easy gradients up to the Mengtsz plain and so on to the Yunnan plateau. Up this road the French intend to carry their railway, and a lot of levelling work has already been done on this portion of the line.

When the river is low, and with a favourable wind, junks accomplish the journey up to Manhao in four or five days, but under adverse circumstances they sometimes take a month. Rather a funny thing happened during the delimitation of the Tonkin-Yunnan frontier a few years ago. Two French officers, attached to the Boundary Commission, having occasion to go down from Mengtsz to Laokay, were asked by their comrades to bring back with them a fresh supply of wines and provisions. By the time they were ready to return the river was in flood, and the journey up to Manhao alone took them 35 days. Moreover, a party of missionaries bound for Yunnan accompanied them up; and, before they reached Mengtsz, they had finished the entire stock of stores, much to the disgust of the other members of the Commission.

Manhao is called the port of Mengtsz. It is the terminus of the larger junks, though the smaller ones can go up as far as Yuanchiang. Manhao is really merely a landing-place for goods on their way to the Yunnan plateau. It is looked upon by the Yunnanese as a most unhealthy spot, and the muleteers of caravans from Mengtsz will never spend the night there. They sleep up in the hills, descend early in the morning, leave their cargo at Manhao, and get away as soon as they have loaded their animals with the goods awaiting them. The mule of Yunnan is a wonderful little animal. It will carry a load of 150 lbs. day after day over the steepest roads of the province in all kinds of weather.

We left Mahano the day following our arrival and proceeded to make acquaintance with the mountains of Yunnan. The road in most places was simply a series of stone steps, and one's first experience of riding up these, though amusing to the onlooker, is unpleasant, the stones are so very, very hard. After crossing the first range above the Red River, we felt that we had earned a good night's rest. This, however, we did not get, as the inns between Manhao and Mengtsz are mere hovels, meant as shelter more for passing pack-animals than travellers. The noise made by the mules, and the chattering of their drivers disturbed us; but the worst enemy to slumber in all Chinese inns is the "chamois"—Mark Twain's variety.

Next day, after crossing a second range of mountains, 6,000 to 7,000 feet above sea-level

we followed a spur down into the plain of Mengtsz. This place, opened by the French to frontier trade in 1889, is the principal port of entry for foreign goods into south and eastern Yunnan. I note, in passing, that 72 per cent. of the whole Import trade into Yunnan, *viâ* Mengtsz, is indisputably British, and 79 per cent. of the total Export trade.

Yunnan has been aptly described as a mountainous desert, with here and there an oasis in the shape of a fertile plain. Most of these plains lie at elevation of from 4,500 to 6,000 feet above the level of the sea, and enjoy a warm, equable climate. The Chinese congregate in these healthy spots, and in the course of years have pushed the original inhabitants, *e.g.*, the Sians and Lolos, into the hills or down into the fever-stricken valleys where they themselves cannot live.

The area of Yunnan is 110,000 square miles, about twice the size of England. Its population is only 8,000,000. Most of the inhabitants dwell in the big centres of the eastern portion of the province—Yunnan Fu, Cheng Chiang, Chao Tung, Linan, &c. It follows, therefore, that large tracts of the province are very sparsely peopled, and almost entirely uncultivated. The poverty of the inhabitants is very apparent, and the traveller wonders why the wealth of Yunnan is so often referred to. The reason, no doubt, is to be found in its position on the map. It is the hinterland of both British Burma and French Tonkin, and the highway from these countries to the richest province of China—Szechwan. That Yunnan is also a part of the Chinese Empire is often forgotten, China being considered, I suppose, a negligible quantity.

The mineral resources of Yunnan are no doubt large, though the mines were worked to a greater extent formerly than now. The copper mines to the north-east have been exploited for centuries: deposits of silver and lead occur in places. Near Mengtsz there are important tin mines; and iron and coal exist in large quantities in the neighbourhood of Tunghai. Zinc and mercury have been found, I believe, by French prospectors. Gold is worked at Talang, and one or two other places; but Yunnan includes no Klondyke within its borders. The situation of most of these mines, however, is unfavourable from a commercial point of view. Heavy cost of transport and distance from the world's markets are factors that have to be reckoned with. I know that the Mengtsz merchants make very little profit on the *tin* they export to Hongkong, but it happens to be for them the most convenient way of paying for some of the goods they import.

As the most valuable article of commercial exchange, however, *opium* has superseded everything for the last 30 years. The cultivation of the poppy in Yunnan can be traced back to the year 1760—eighty years before our so-called Opium War with China—and the Yunnanese are further credited with having discovered the way of smoking the drug. The production of opium in any quantity dates from the time of the Mahommedan Rebellion, which killed the silk industry, and closed half the mines in the province. The want of some product, easily transportable, with which they could pay for their needs, led the Yunnanese to turn their attention more and more to the cultivation of the poppy. The annual output is now not far short of 5,500 tons, whils in the neighbouring province of Szechwan it is considerably more. Indian opium, which the sophist accuses us of forcing on the Chinese, is, on entry into China, handicapped by an exceedingly heavy import duty. In a few years' time it is bound to be ousted from the Chinese market by the native article, and the great "Opium Question" will then no longer concern us. Opium smoking is, no doubt, a terrible vice, but it is preferable, in some respects, to what is known as *our* "national sin." The opium smoker never wants to go "mafficking," or paint the town red, to the great discomfort of respectable citizens!

Salt for local consumption is all obtained from mines and brine wells within the province, and carried by pack-animals to the various markets. When the brine is drawn from the wells, it is poured into large iron pans, under which a fire is set, and the salt obtained by evaporation.

With the exception of the minerals referred to, Yunnan possesses no product suitable for exportation, and possible goods for carriage by projected Burma-Yunnan or Tonkin-Yunnan railways are hard to think of. The trade that might eventually arise in live stock has been made much of, and certainly many parts of the Yunnan plateau are particularly suited to the breeding of sheep, oxen and ponies.

This question of railways into Yunnan is one on which there exists considerable differences of opinion. It can be viewed from the commercial or political aspect, and may briefly be summed up as follows:—The French have obtained a concession to extend their railway

from Laokay to Yunnan Fu. The construction of this line, it is thought by some, will "interpose an insurmountable barrier of French influence between Burma and Western China" to the prejudice of British trade. The Indian Government is, therefore, urged to construct an opposition line from the Kunlung Ferry to Tali Fu. The distances as the crow flies are about equal, but it is not denied that the engineering difficulties of the British line are far greater than those to be overcome by the French.

The French are greatly favoured in two respects. Tonkin is much nearer than Burma to the richest and most populous portions of the province; and, owing to the trend of the country, the approaches to Yunnan from Tonkin run parallel with the mountain ranges. Situated thus, the French are bound to extend their influence in Yunnan, but the statistics of the trade of Mengtsz prove, I think, that commercially, we have no cause to fear their rivalry.

From Burma the railways suggested would have to traverse, or *dodge*, the chains of mountains which divide the Mekong and Salween Rivers and their numerous affluents. I am aware that, thanks to the action of the Yunnan Company, and the help accorded them by the Indian Government, a route has been found from Kunlung which avoids the steeper gradients; but the railway proposed could be built only at an immense cost, and even then as the Western portion of the province is wretchedly poor, to compete with the French railway it would have to be carried on over most difficult country to Yunnan Fu. The trade possibilities of the province, viewed ever so optimistically, do not, I think, warrant such a huge undertaking; and I see in the passive attitude of the Indian Government, not blindness to the political importance of such railway schemes, but merely a hesitation to burden themselves with the financial responsibility.

A line that could be built at a comparatively small cost, and that would pay, is one from Bhamo, our trade mart on the Irrawaddy, to Tengyueh, the port of Western Yunnan.

The hostility of the population to railway schemes was shown in the riots which broke out at Mengtsz, in June, 1899. A mob attacked the foreign settlement there in the middle of the night, and burnt two houses occupied by the Commissioner and members of my own service.

For many years to come the Yunnanese will have to depend on their present means of transport. Besides the mule, there is the bullock, also used as a pack animal. The water buffalo, though strictly speaking an agricultural animal, is sometimes harnessed to a rough cart used, equally, to carry stones, or to take a party of Yunnanese ladies to some temple on the hills. In it they also visit their family graves, an act of piety that more often develops into a happy picnic.

Reference to family graves brings us to funerals. The three important occasions of a Chinaman's life are his birth, his marriage, and his death. In Yunnan the last is the event which calls for most display. On the death of a relative even the poorest family gives a feast to which all their friends are invited. The funeral car used has a paper Stork on top. It is the emblem of immortality. The Goose is, similarly, the symbol of conjugal felicity. A paper one is always stuck up on a pole outside the house of a newly-wedded couple in Yunnan. So that the rich man may have every comfort when he wakes in the Buddhist purgatory, paper images of what he will most need are made, and after being carried in his funeral procession are burnt at his graveside. There is for instance his horse, with groom in charge. Four paper bearers also carry his sedan chair, ready for him to step into when he lands on the other side of the Styx. The mourners at a Yunnanese funeral wear white, not black, another instance of their topsy-turvydom. To the principal guests at the funeral two pieces of white cloth are given, one for the head, the other for the waist.

From funerals I turn for a moment to other examples of Yunnanese customs, in which a procession forms the distinctive feature. There is the "Ying Chun" Festival or ceremony of meeting the Spring. The chief official of the place is then borne on a special car to a small temple marking the eastern boundary of his town. There he meets the plaster figure of a buffalo, supposed to represent the Spring, with which after worshipping at the temple he returns in state to his residence.

At another procession during the year, an idol (that is presumably in need of an airing) is borne round the town on the shoulders of respectable shopkeepers.

But the prettiest processions take place every spring and autumn to mark the seasons' changes. Then the people make what they call "Flower Cars." Little boys, dressed to represent the heroes and heroines of antiquity, are perched up aloft on iron bars, and as the cars move along, borne on men's shoulders

ıey wave their fans and nod their heads. 'he whole effect is very picturesque and leasing.

The Chinese are past masters in the art of ·rigating their fields. Their staple food, rice, ıust be grown in water until it ripens, and in 'unnan they have all kinds of ingenious ways f carrying water on to their farms. One ıethod is the wheel that is turned by a stream, nd to which is attached hollow pieces of amboo. These fill and empty themselves utomatically into a wooden shoot leading ıto the fields.

After the rice is harvested, it has to be ulled or skinned before it can be eaten, and his labour calls for a further display of ıgenuity. The apparatus used in many illages consists of a wooden log, hollowed .t one end, and with a piece of hard wood astened through the other. The log is evenly ıalanced, and a stream of water is directed on o the hollow end, which sinks down under the ᵥeight of water, empties itself, and rises again. 'he other end falls continually on to the grain, .nd loosens the husk.

The Yunnanese live almost entirely on rice .nd vegetables. When they can afford it hey buy some pork, or kill a fowl, but neat to the majority of the inhabitants is luxury. Only the Mahommedans eat beef, ınd where they live beef can usually be pur-:hased daily in the market. The Mahommelans in Yunnan are probably descended from he soldiers stationed there by the Great Mongol Ǝmperor, Ghenghis Khan, when he invaded Burma and India in the 13th century. In 855 occurred their terrible rebellion, and the Mahommedans kept the field against the mperialist troops till 1873. The Chinese :ventually gained the ascendency, but not ›efore the population of the province had been educed by many millions.

The first Chinese settlers intermarried freely vith the native tribes around them, and the esult is that the beliefs and customs of their lescendants, the Yunnanese of the present day, liffer in many respects from those common to ›ther parts of China. They are intensely ;uperstitious, and believe in divination of all ‹inds. They would even have faith, I believe, n the weather forecasts of our Meteorological Department. The local diviner is usually a ›lind man. When a young man wishes to ;tart a home of his own, he does not go on ıis knees and ask some sweet maid to be his :verlasting cook and stocking darner. He ›btains instead her "card of nativity" through one of the recognised match-makers of the place, and sends it with his own to a diviner. If the "stars are in conjunction" negotiations can continue, but if they don't agree all is at an end! At least he must seek elsewhere.

Phrenology is not practised, so far as I am aware, but physiognomists get a good living amongst the Yunnanese. A Chinaman is not supposed to grow a moustache until he is at least 30 years of age. He makes a virtue of necessity in this case. However, when he does want to increase his attractions, the Yunnanese applies to a physiognomist, who will discover for him a lucky day on which to start growing a moustache.

In Yunnan the "five senses of man" are said to be the ears, eyes, mouth, nose, and eyebrows. Blue or grey eyes are rarely met with amongst the Chinese, the prevailing colour being black. The consequence is that the Yunnanese attribute extraordinary powers to our eyes. According to them we can see the precious minerals in the earth. I have even been asked by some country people to aid them to find the silver supposed to have been hidden by their parents in their garden during the Mahommedan rebellion.

The Yunnanese lady is fond of dressing herself and her children in bright colours. The most favoured material is Szechwan flowered silk; but for ordinary wear coloured cotton cloth, made and dyed locally, is in general use. Woollen cloth is much appreciated, but is very dear, all on the market being of British or German manufacture. As jewellery—earrings, bracelets, rings, necklaces, and hair ornaments are worn. These are generally made of silver, but the very poor classes manage with brass or pewter.

In India the would-be beauty must imitate the waddle of an elephant. In China the "waving willow" walk is held up as the acme of perfect progression for women. To obtain this walk mothers bind the feet of their girl-babies in rather a cruel fashion, so as to make them small and pointed. In Yunnan it is only the girls of the richer classes whose feet are permanently deformed. It is a silly custom, of course; but one thing may be said in its favour, and it is probably why the women have so long permitted themselves to be the victims of such a fashion. On account of their bound feet the Chinese women are not compelled to slave in the fields like the women of every other Eastern race, whilst their husbands loaf at home. To be in the fashion, the Yunnanese women of the poorer classes bind their feet

with cotton bandages, so as to make them appear smaller, but beyond giving them the necessary willowy step, it does not seem to hurt them in any way.

To turn once more from frivolous to serious consideration of our subject. It is 18 days journey by mule caravan from Mengtsz to Szemao. The main road leads through Linan, Shihping, noted for its lovely lake, Yuanchiang, a small, fever-stricken, walled city, on the Red River, Talang, and Pu-Erh. The road lies over mountain ranges, down the beds of streams, and up wooded valleys, never monotonous, but often difficult. Just east of Yuanchiang the road crosses a range 8,000 feet high, descending immediately after the Red River, only 1,500 feet above the sea at that place. The climb on the opposite side is a very stiff one, and the best way is to cling on to your pony's tail and let him pull you up.

The roads in Yunnan, generally, are in a deplorable condition. The bridges, however, are a noticeable feature of the province. The curve of the ordinary stone ones is unnecessarily high in proportion to the width of the streams they span. Between Yuanchiang and Talang, there are two rather fine chain suspension bridges. They span the Papien and the Homa rivers, which unite further south, and enter Tonkin as the Black River. The planking in the centre of these bridges is purposely left loose, and is, in fact, very unsafe. This is to prevent caravans of pack animals from passing over in a body, and causing too great a strain on the structure. At preseut only two or three can cross at a time, and they have to pick their steps most carefully.

The scenery on the road was most superb, and the vegetation most varied, the flowers at different elevations corresponding to those of the Tropics, and the Temperate and Frigid zones respectively. In fact Yunnan is the botanist's paradise.

Szemao is a busy town of 10,000 inhabitants, healthily situated on a little rising in the centre of a typical Yunnan plain. It was opened to frontier trade in 1896, and Consuls for both Great Britain and France appointed there. It was found, however, that the commercial importance of the place had been over-estimated and both Consulates have lately been suppressed. In return, a Consulate General has been established at Yunnan Fu, the capital of the province.

The trade of Szemao is principally in the famous Pu-Erh tea, that is held in such great esteem by the Chinese of other provinces. Raw cotton is imported from the British Shan States; but other necessaries of life, *e.g.*, matches, woollen cloth, lamps, &c., are supplied from Mengtsz.

The architecture of Yunnan has characteristics of its own, notably so in the pointed gables that adorn the houses and temples. The walls, though built of sun-dried and burnt bricks, form no part of the structure of a house, and might fall down without causing a general collapse. The woodwork in all cases supports the roof, and is the solid portion of their buildings. The "guardian" figures outside their temples are rather quaint, their conception of a "lion" being particularly funny.

The animals best known to the Yunnanese are the elephant, tiger, panther, bear, wild boar, sambhur, or big deer, several varieties of small deer—including the musk deer, the fox, wolf, monkey, and wild cat. There are others, but this will suffice to show the variety existing in the province. The panthers at Szemao are rather a nuisance. On three occasions whilst I was out riding on the hills my dog was attacked by a panther. Young bears are sometimes brought into the market for sale. Elephants are found in a wild state in the Chinese Shan States. Some of the Shan chiefs own tame ones, and at rare intervals these are sent into Szemao, as a mark of respect to the Chinese officials.

In the neighbourhood of Szemao live many of the aboriginal tribes, whom the Chinese, in their gradual march westwards, have ousted from their former homes in the plains. The Lolos, so often referred to by travellers, are scattered all over Yunnan. Only in one place in the north of the province, do they exist as a separate and independent community. They possess a language and literature of their own, though very few of them can now write and read their own characters. Their religion is a form of spirit worship, and consists chiefly in propitiating the evil spirits, so that no harm may come to the inmates of the house. The religion of all these native tribes is a simple one, based on old legends, and arising in the first instance from an attempt to account for the three inexplicable mysteries — Dreams, Disease, and Death.

The Lolos are fond of music and dancing, amusements they indulge in on moonlight nights. Their dancing is not quite like ours. Although both sexes take part in it, they evince no desire to hug each other. They simply move around in a circle, and stamp their feet in time with the music.

The Woni race are supposed to be the oldest inhabitants of Yunnan. They are divided into numerous clans, each wearing different dresses, with as much variety of colour and detail as in the tartans of the Scottish clans. The men, as a rule, wear the blue cotton jacket and trousers common to the poorer classes throughout China; but the women retain the picturesque costume of their tribe. The Akka of the Shan States belong to the Woni race, as do also the Putu and the Mahê. The Mahê lead a wretched existence. They dwell in tiny little bamboo and mud hovels on the outskirts of Szemao and Pu Erh, and act as "hewers of wood and drawers of water" to the Chinese. Every day they go out, young and old, to the neighbouring hills in search of firewood, which they bring into the town toward evening. They sell as much as they can carry for 75 cash, equivalent to 2d. in our money. They never grow rich!

I shall not have time this evening to describe any more of these hill tribes, but I should like to mention, in passing, the interesting "Wa" tribes, wild and tame, of the Meng Lem district.

My homeward journey led me through the Shan States and Burma. The healthy portion of the Yunnan plateau terminates in most abrupt fashion a few miles beyond Szemao, and one literally tumbles off the edge, down into the lower plains and valleys inhabited by the Shans. Szemao is the last town, and I may add the last centre of civilisation in this direction, until British territory is reached; for south or west beyond Szemao there doesn't exist a single inn for the convenience of travellers. The only way is to camp out, or sleep in the Shan temples *en route*. Except in bad weather, a tent is preferable, and even the muleteers either sleep under a piece of stout cloth held off the ground by sticks, or erect a shelter of branches, roofed with grass. I have stayed in Shan temples, and slept very comfortably under the shadow of the great gilt Buddha, but the awakening was always somewhat of a shock, as it is the practice for the priests and the boy novices to kneel down every day at dawn, and yell their morning orisons.

The capital of the Chinese Shan States is Kenghung, on the Mekong, the residence of the Saw Bwa, or Hereditary Chieftain, who is the nominal ruler of the "Sip Song Panna," *i.e.*, the "Twelve States." From Szemao to this place it is six days' journey. Though the plain of Kenghung lies at an elevation of 2,100 feet above the sea, it is considered by the Chinese to be a most unhealthy spot. Through it runs the Mekong, here nearly 200 yards wide, and crossed by a rude ferry.

The houses of the Shans are usually constructed on piles, their living apartments being thus well off the ground. They do not copy the architecture of the Chinese, and the few bridges that one meets with are of wood or bamboo, and very frail.

One custom of the Chinese Shans is worth noting. At the New Year the young girls provide themselves with balls, like a small pincushion in shape, filled with cotton seed, and covered with pieces of coloured cloth. To one side is attached a long string with streamers. These are thrown by the girls from a certain distance to the young men. By catching or missing them the youths show their preference, and marriage engagements are the result. To obtain some photographs I joined in the game, but I was careful to show no preference.

From Kenghung to Kengtung it is another ten days by caravan. There is nothing to be said in connection with our journey thither, except that the roads were worse if anything than any I have yet seen. Plains give way to mountains, mountains to valleys, and valleys to plains; rarely did we get any level road. Occasionally we came to a river, which the animals had to swim, whilst the baggage was carried across in clumsy boats.

Twelve days out from Szemao we crossed the Burma frontier, marked by a wooden post and a heap of stones. As we neared Kengtung we found evidence of British influence in the roads; they were wider and better kept than those we had been traversing. The country around produces cotton, tea, and a little opium.

Four days later, after negotiating the usual mountain barrier, we descended into the fine plain of Kengtung. This place is one of the outposts of our Empire. It is the residence of a political officer, who, whilst subordinate to the Superintendent of the Southern Shan States, is in charge of the Kengtung State, extending from the Chinese frontier on the north, to Siam on the south. Kengtung is garrisoned by Indian troops, and possesses a post and telegraph office.

Big forests of teak exist in Kengtung territory, near the Siamese frontier, and are worked by the Sawbwa under British supervision.

The Bazaar at Kengtung is one of the sights of British Burma. On market day it is thronged

with people dressed in every conceivable colour, and the scene is most animated. Lightly clad Siamese, natives of Laos, swarthy Indians, stolid Cantonese pedlars, Burmese, Shans, and numerous hill tribes jostle each other, and the babel of languages once heard is not easily forgotten.

The Shan, or "Tai" race is divided into many clans. The inhabitants of Kengtung are known as "Kuns," those of the Chinese Shan States, as "Lü," of Meng Lem as "Lem," &c.

There is a good mule-track between Kengtung and the Salween. Two very high mountain ranges have nevertheless to be negotiated, but a new route has lately been surveyed that avoids the steeper hills, and a big cart road will shortly be ready for caravans. After leaving Kengtung one travels in comparative comfort. At most of the stages along the road bungalows have been built for the traveller. Seven days' travelling brought us to the Salween, at a place called Takaw. We crossed the river by a ferry boat similar to the one at Kenghung. The ferry system in the Shan States certainly needs amelioration.

Two days later we reached the pretty Namkham River, one of the tributaries of the Salween, and the following day arrived at Hsai-Kao, where there is a post and telegraph office. From Hsai-Kao, a good, wide road led us across undulating plains, resembling the downs of Wiltshire. Water in many places is rather scarce; but with this defect remedied no country would be better suited for colonisation. Like Yunnan, the Shan States could well support a larger population. Amongst the present inhabitants are the "Red Yang" tribe whose dress is very curious. I was glad to add a photo of them to my collection.

Seventeen days out from the Kengtung we arrived at Taunggyi, the capital of the Southern Shan States. It is a prosperous, and growing British settlement, situated in a splendidly chosen spot in a plain 4,600 feet above the sea. This place was only a tiny hamlet twelve years ago. About that time, Mr. Hildebrand, until last year Superintendent of the Southern Shan States, happily selected Taunggyi as his official residence, and it now bids fair to rival that well-known sanatorium of Burma—Maymyo. Trade is thriving, thanks to the construction of good cart roads, and we are bound to hear more of Taunggyi as a commercial centre in the future.

From Taunggyi we turned south to the older military settlement, Fort Stedman, distant one day's march only. Fort Stedman is situated on the eastern shore of Lake Yawng Hwe. The place is much lower and hotter than Taunggyi. Proximity to water could have been the only reason for choosing it as a residence for troops.

Sending my caravan round the lake, I crossed myself in a small dug-out. The shores and islands of the lake are inhabited by the Inthas—a hybrid tribe of Burmese origin. Their method of paddling with their legs is, I believe, absolutely unique. Standing on the gunwale of the boat, they balance themselves on one leg, and twisting the other round the long paddle force the blade back through the water. In this way they send the boat along at a great speed.

The third morning after quitting Lake Yawng Hwe, we finally left the hills behind us, and descended into the hot plains of Lower Burma. For the next two days the roads, though wide and level, were horribly dusty, and the heat and glare intense. We struck the Rangoon-Mandalay railway at Thazi, a small junction town, where I paid off my caravan. We had taken 48 days in coming from Szemao, and in spite of the different altitudes traversed, none of us were ill on the way, a result, I expect, of the quinine that I occasionally dispensed to all.

From Thazi I went down to Rangoon; then wishing to see a little more of Burma, I took the night mail up to Mandalay. A large proportion of the Chinese population of Mandalay are natives of Yunnan, who have, in most cases, taken Chinese wives, and settled there. Continuing my railway journey I went right up to the northern terminus, Myitkina, a settlement on the upper reaches of the Irrawaddy, quite close to the Chinese frontier. Some speculators are dredging for gold in that river, just above Myitkina.

From Myitkina, I went down on a Government launch, kindly placed at my disposal by Sir Frederic Fryer, through the wonderful gorges of the Irrawaddy, rarely visited by travellers, though well worth seeing. At Sinbo just above the first defile, the river, at the commencement of the rains, rises sometimes as much as 84 feet, owing to the narrowness of the passage lower down. We went down with the current, at a good pace, to Bhamo, a trade-mart and military station—also the terminus of the Irrawaddy steamers. Bhamo is growing wonderfully, and trade with Yunnan across the frontier steadily increasing.

From Bhamo, I continued my way down the river on one of the Irrawaddy Flotilla Com

pany's well-appointed steamers. I enjoyed this part of my trip immensely, and am only surprised that the lovely scenery of the Upper Irrawaddy, with its pagoda-lined banks, does not attract more travellers.

It is getting late, however, so with a passing reference to the "Shwe Dagon," or Golden Pagoda of Rangoon, I bring my paper to a conclusion.

DISCUSSION.

The CHAIRMAN, in thanking Mr. Carey, said that that gentleman had served in China, first under the Imperial Customs Department, with Sir Robert Hart, and had spent seven years of his life in Yunnan. So that no man was able to give a better account of the countries with which his paper dealt, than he. During the last two years he had served in the British Consular service in Yunnan, and while there, being a most expert photographer, he had taken the large number of excellent pictures which he had shown on the screen that evening. He, himself, saw enough to recognise how exceedingly good the pictures were. It had been the hope of the authorities of the Society of Arts to have had as chairman that evening Sir Hugh Barnes, the Lieutenant-Governor designate of Burma. Unfortunately, however, Sir Hugh had to be in the country. To him (the Chairman) the paper was particularly interesting, for, although he had never set foot in the actual territories which Mr. Carey had traversed, he recognised so many traits in regard to scenery, custom, and the appearance of the people, like those with which he had been familiar among the Indo-Chinese tribes all along our Eastern frontier. For instance, one picture showed the use of the solid wheel, another the mode of irrigation, while yet another exhibited huts built upon piles. Still further he recognised the similarity in the native dances, and the plaids which designated the different tribes. All that kind of thing one met among the tribes to the east of Assam, Manipur, and right down to the frontier. The only point in the paper upon which he had anything serious to say, was with regard to the railway from Burma to Yunnan. Upon that he entirely agreed with Mr. Carey. Lord Curzon, when at Rangoon a year or so ago, expressed his opinion in very plain terms, saying that if there was any money to spend, the communications in Burma had the first call upon it. But there was a great deal to do in the interior, said Lord Curzon, before it would be just to spend any of the Indian taxpayers' money upon what was a doubtful thing, commercially and politically, in regard to Yunnan. He (the Chairman) concluded that Lord Curzon was right in saying that he would hold his hand.

Obituary.

THOMAS WARD, J.P.—Mr. Ward, of Wadebrook-house, Northwich, whose death occurred on Wednesday evening, 18th inst., at the age of 68, had been for some years a member of the Society of Arts. He was Managing Director of the Salt Union and Chairman of the British Salt Association. In December, 1894, he read a paper before the Society on "The Manufacture of Salt," for which he received a silver medal. At the general election of 1895 Mr. Ward contested the Northwich Division in the Unionist interest, but was defeated by Sir John Brunner.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock :—

MARCH 4.—"Education in Holland." By J. C. MEDD. The HON. LYULPH STANLEY, M.A., will preside.

MARCH 11.—"Existing Laws, By-laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions." By T. BRICE PHILLIPS. (Fothergill Prize Essay.) SIR WILLIAM H. PREECE, K.C.B., F.R.S., will preside.

MARCH 18.—"New Aspects of Life Assurance." By WILLIAM SCHOOLING.

MARCH 25.—"Oil Lighting by Incandescence." By ARTHUR KITSON.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

MARCH 12.—"The Currency Policy of India." By J. BARR ROBERTSON. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

APRIL 23.—"The Province of Sind." By HERBERT MILLS BIRDWOOD, C.S.I., M.A., LL.D. The EARL OF LYTTON will preside.

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 or 5 o'clock :—

MARCH 3, at 4.30 p.m.—"The Uganda of To-day." By HERBERT SAMUEL, M.P. Sir HARRY H. JOHNSTON, G.C.M.G., K.C.B., will preside.

MARCH 31, at 4.30 p.m.—"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo. The RIGHT HON. SIR GEORGE TAUBMAN GOLDIE, K.C.M.G., will preside.

MAY 5, at 4.30 p.m.—"The Lagos Hinterland: its People and its Products." By MAJOR J. H. EWART.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock.

MARCH 17. 4.30 p.m.—"Artistic Fans." By MISS HANNAH FALCKE. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

PROF. J. A. FLEMING, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." Four Lectures.

LECTURE I.—MARCH 2.—*General Principles. The Theory of the Radiator or Aerial.*—Introductory remarks—The production of an electric wave—The theory of the aerial or radiator—Comparison between organ pipes and Hertzian wave radiators—The propagation of an electric wave over earth or water surface—Fundamental and harmonic electrical oscillations in radiators—The Marconi radiator—The Braun radiator—The Slaby radiator—Oscillation transformers and multiplicators.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 2...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. J. A. Fleming, "Hertzian Wave Telegraphy in Theory and Practice." (Lecture I.)

Farmers' Club, Salisbury-square Hotel, Fleet-street, E.C., 4 p.m. Mr. Edwin Clements, "Railway Rates for the Carriage of Agricultural Produce."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. W. Worby Beaumont, "Road Traffic in and near Large Cities."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Mr. Thomas Tyrer, "The need of a Duty-Free Alcohol for Industrial Purposes."

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. E. W. Pulling, "A Tour round the World. No. II.: The Malay States, China, and Japan."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Paper by Cavaliere W. P. Jervis.

Medical and Chirurgical, 20, Hanover-square, W., 5 p.m. Annual Meeting.

TUESDAY, MARCH 3...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Mr. Herbert Samuel, M.P., "The Uganda of To-day."

Alpine Club, Savile-row, W., 3½ p m. Mr. H. Woolley, "The Canadian Rockies."

Royal Institution, Albemarle-street, W., 5 p.m. Sir William Abney, "Recent Advances in Photographic Science." (Lecture II.)

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. George Frederick Zimmer, "Mechanical Handling of Material."

Pathological, 20, Hanover-square, W., 8½ p.m.

Anglo-Russian Literary Society, Imperial Institute, South Kensington, S.W., 3 p.m. Mr. F. H. Skrine, "Some Phases of Russian History."

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. J. T. Cunningham, "Observations and Experiments on Japanese Long-tailed Fowls." 2. Mr. E. R. Sykes, "The Land Operculate Mollusca collected during the 'Skeat Expedition' to the Malay Peninsula." 3. Mr. R. Lydekker, "The Significance of the Callosities on the Limbs of the *Equidæ*."

WEDNESDAY, MARCH 4...SOCIETY OF ARTS, John-street, Adelphi, W C., 8 p.m. Mr. J. C. Medd, "Education in Holland."

United Service Institution, Whitehall, S.W., 3 p.m. Major-General C. E. Webber, "An Organisation of the Nation for Defence."

Entomological, 11, Chandos-street, W., 8 p.m. 1. Mr. G. A. James Rothney, "The Aculeate Hymenoptera of Barrackpore, Bengal." 2. Mr. Charles Owen Waterhouse, "Notes on the Nests of Bees of the Genus 'Trigona.'" 3. Colone Charles Swinhoe, "The Aganiidæ in the British Museum, with descriptions of some New Species."

Archæological Association, 32, Sackville-street, W. 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Viscount Dillon, "Armour Notes."

THURSDAY, MARCH 5...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. W. S. Rowntree, "Some Points in the Visceral Anatomy of the Characinidæ." 2. Mr. F. G. Parsons, "The Anatomy of the Pig-footed Bandicoot *Chœropus Castanotis*." 3. Dr. Elliot-Smith, "Furthur Notes on Lemurs."

Chemical, Burlington-house, W., 8 p.m. 1. Mr. H. Bassett, "The mechanism of the reduction of potassium bichromate by sulphurous acid." 2. Mr. H. A. D. Jowett, "The constitution of pilocarpine, Part IV." 3. Messrs. H. A. D. Jowett and C. E. Potter, "Preparation and properties of 1.4 (or 1,5) dimethyl glyoxaline and 1,3 dimethyl pyrazole." 4. Mr. R. G. Hill, "Some analyses of 'Reh,' or the alkaline salts in Indian Usar land." 5. Messrs. W. H. Perkin and J. F. Thorpe, "Experiments on the synthesis of camphoric acid. Part III. Synthesis of isolauronolic acid." 6. Messrs. T. M. Lowry and G. C. Dorrington, "Camphor-β-thiol." 7. Mr. F. D. Chattaway, "Isomeric change of dibenzanilide into benzoylorthoamino- and benzoylparaamino-benzophenone." 8. Messrs. J. C. Cain and F. Nicoll, "The rate of decomposition of diazo-compounds. Part. III.: The temperature co-efficient."

Royal Institution, Albemarle-street, W., 5 p.m. Prof L. C. Miall, "Insect Contrivances." (Lecture II.)

National Indian Association, Jehanghir Hall, Imperial Institute-road, S.W. Mr. R. Masujima, "The Japanese Code regarding Family Law."

Junior Art Workers' Guild, Clifford's-inn, Fleet-street, E.C., 8 p.m. Mr. Cyril Davenport, "Bookbinding."

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. R. W. A. Brewer, "The Production of Power by means of Gas Producers and Engines."

FRIDAY, MARCH 6...Art Workers' Guild, Clifford's-inn, Fleet-street E.C., 8 p.m. Lecture on "Carpaccio."

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Dr. J. G. McKendrick, "Studies in Experimental Phonetics."

Geologists' Association, University College, W.C., 8 p.m.

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, MARCH 7...Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "Light: its Origin and Nature." (Lecture III.)

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FRIDAY, MARCH 6, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, March 9, 8 p.m. (Cantor Lectures.) Professor J. A. Fleming, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." (Lecture II.)

Wednesday, March 11, 8 p.m. (Ordinary Meeting.) T. Brice Phillips, "Existing Laws, By-Laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions." (Fothergill Prize Essay.)

Thursday, March 12, 4.30 p.m. (Indian Section.) J. Barr Robertson, "The Currency Policy of India."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES ON "THE FUTURE OF COAL GAS."

Professor Vivian Lewes's Cantor Lectures on "The Future of Coal Gas and Allied Illuminants" have been reprinted from the *Journal.*

The pamphlet (price 1s.) can be had on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

A full list of the Cantor Lectures which have been published separately and are still on sale, can be obtained on application to the Secretary.

FIRE PREVENTION PRIZES.

The Council of the Society of Arts, at the request of the Executive Committee of the International Fire Prevention Exhibition, have decided to offer, out of the funds of the Fothergill Trust, the following prizes at the Exhibition which is to be held at Earl's Court during the current year:—

For the best chemical fire engines for town use shown at the Exhibition:—One gold medal, two silver medals, and two bronze medals.

For the most easily worked long ladders, to reach the sill of a window 80 feet above the level of the pavement, which shall also be capable of being rapidly transported over roads of not more than 25 feet wide, shown at the Exhibition:—One gold medal, two silver medals, and two bronze medals.

The medals will be awarded by the Council on the report of the judges appointed by the Executive of the Exhibition.

The Council reserve the right of withholding any of the medals, or of awarding medals of lesser value, if in their opinion the exhibits should not be deserving of any, or all, of the medals offered.

CANTOR LECTURES.

On Monday evening, 2nd inst., Professor J. A. Fleming, F.R.S., delivered the first lecture of his course on "Hertzian Wave Telegraphy in Theory and Practice."

The Lectures will be printed in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday afternoon, March 3, 1903: Sir Harry H. Johnston, G.C.M.G., K.C.B., in the chair. The paper read was "The Uganda of To-day." By Herbert Samuel, M.P.

The paper and report of the discussion will be published in a future number of the *Journal.*

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1903 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before the 4th April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded as follows in previous years:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Michael Faraday, D.C.L., F.R.S., "for discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S., "for the invention and manufacture of instruments of measurement and uniform standards by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I., "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., Member of the Institute of France, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential services in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious labour."

In 1879, to Sir William Thomson (now Lord Kelvin), LL.D., D.C.L., F.R.S., "on account of the signal service rendered to Arts, Manufactures, and Commerce, by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science to industrial pursuits."

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin, "for eminent services rendered to the Industrial Arts by his investigations in organic chemistry, and for his successful labour in promoting the cultivation of chemical education and research in England."

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S., "for his researches in connection with fermentation, the preservation of wines, and the propagation of zymotic diseases in silkworms and domestic animals, whereby the arts of wine-making, silk production, and agriculture have been greatly benefited."

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S., "for the eminent services which, as a botanist and scientific

traveller, and as Director of the National Botanical Department, he has rendered to the Arts, Manufactures, and Commerce by promoting an accurate knowledge of the floras and economic vegetable products of our several colonies and dependencies of the Empire."

In 1884, to Captain James Buchanan Eads, "the distinguished American engineer, whose works have been of such great service in improving the water communications of North America, and have thereby rendered valuable aid to the commerce of the world."

In 1885, to Mr. (afterwards Sir) Henry Doulton, "in recognition of the impulse given by him to the production of artistic pottery in this country."

In 1886, to Samuel Cunliffe Lister (now Lord Masham), "for the services he has rendered to the textile industries, especially by the substitution of mechanical wool combing for hand combing, and by the introduction and development of a new industry —the utilisation of waste silk."

In 1887, to HER MAJESTY QUEEN VICTORIA, "in commemoration of the progress of Arts, Manufactures, and Commerce throughout the Empire during the fifty years of her reign."

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S., "in recognition of the value of his researches in various branches of science and of their practical results upon music, painting, and the useful arts."

In 1889, to John Percy, LL.D., F.R.S., "for his achievements in promoting the Arts, Manufactures, and Commerce, through the world-wide influence which his researches and writings have had upon the progress of the science and practice of metallurgy."

In 1890, to William Henry Perkin, F.R.S., "for his discovery of the method of obtaining colouring matter from coal tar, a discovery which led to the establishment of a new and important industry, and to the utilisation of large quantities of a previously worthless material."

In 1891, to Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S., "in recognition of the manner in which he has promoted several important classes of the Arts and Manufactures, by the application of Chemical Science, and especially by his researches in the manufacture of iron and of steel; and also in acknowledgment of the great services he has rendered to the State in the provision of improved war material, and as Chemist to the War Department."

In 1892, to Thomas Alva Edison, "in recognition of the merits of his numerous and valuable inventions, especially his improvements in telegraphy, in telephony, and in electric lighting, and for his discovery of a means of reproducing vocal sounds by the phonograph."

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S., "for their joint services to scientific agriculture, and notably for the researches which, throughout a period of fifty years, have been carried on by them at the Experimental Farm, Rothamsted."

In 1894, to Sir Joseph (now Lord) Lister, F.R.S., "for the discovery and establishment of the antiseptic method of treating wounds and injuries by which not only has the art of surgery being generally promoted, and human life saved in all parts of the world, but extensive industries have been created for the supply of materials required for carrying the treatment into effect."

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S., "in recognition of the services he has rendered to Arts, Manufactures, and Commerce by his metallurgical researches and the resulting development of the iron and steel industries."

In 1896, to Prof. David Edward Hughes, F.R.S., "in recognition of the services he has rendered to Arts, Manufactures, and Commerce, by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone."

In 1897, to George James Symons, F.R.S., "for the services he has rendered to the United Kingdom by affording to engineers engaged in the water supply and the sewage of towns a trustworthy basis for their work, by establishing and carrying on during nearly forty years systematic observations (now at over 3,000 stations) of the rainfall of the British Isles, and by recording, tabulating, and graphically indicating the results of these observations in the annual volumes published by himself."

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For. Memb. R.S., "in recognition of his numerous and most valuable applications of Chemistry and Physics to the Arts and to Manufactures."

In 1899, to Sir William Crookes, F.R.S., "for his extensive and laborious researches in chemistry and in physics; researches which have, in many instances, developed into useful practical applications in the Arts and Manufactures."

In 1900, to Henry Wilde, F.R.S., "for the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small, a discovery now used in all dynamo machines; and for its application to the production of the electric search-light, and to the electro-deposition of metals from their solutions."

In 1901, to HIS MAJESTY THE KING, "in recognition of the aid rendered by His Majesty to Arts, Manufactures, and Commerce during thirty-eight years' Presidency of the Society of Arts, by undertaking the direction of important exhibitions in this country and the executive control of British representation at International Exhibitions abroad, and also by many other services to the cause of British Industry."

In 1902 to Professor Alexander Graham Bell, "for his invention of the Telephone."

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

Proceedings of the Society.

INDIAN SECTION.

Thursday afternoon, February 26, 1903; SIR ROBERT J. C. MOWBRAY, Bart., M.P., in the chair.

The CHAIRMAN said it required few words of his to introduce to the meeting, Mr. Baines. Everyone knew the interest which was taken by the Indian Section of the Society of Arts in everything which was connected with the Indian Empire. Moreover, all who had taken an interest in the work of that Section knew the work which Mr. Baines had done for it. The present paper would make the fourth which that gentleman had delivered before the Society, and, doubtless, the author would receive a very careful and attentive hearing.

The paper read was—

GLEANINGS FROM THE INDIAN CENSUS.

By JERVOISE ATHELSTANE BAINES, C.S.I.

A few years ago, when the late census was under preparation, I received a visit from one who had been among the ablest of my colleagues in the operations of 1891, and I asked if he were inclined to take a more prominent part, if the chance occurred, in the census work of 1901, and he promptly answered, "no fear." This, by itself, might have been taken as an expression of mere personal taste, but when he went on to add that he could not conceive how anyone who had once had to do with a census could touch it again, even with a pair of tongs, he showed, I think, an unexpected poverty of imagination. Old habits, whether bad or good, die hard. Charles Lamb, within a week of his retirement, found himself obliged to loaf round to the India Office and contemplate his successor at *his* desk, doing what he still thought to be *his* work. Retired Indian officials, in the same way, betake themselves to the Society of Arts, where they get the opportunity of joining in the discussion of matters in which they once took leading parts, and I have even met them listening to an Indian Budget in the Strangers' Gallery, though not, I admit, in large crowds. Like other branches of the administration, census-taking with the utilisation of its results, has its good points, and I am here to-day to explain some of them, and to justify my position that the subject is not one requiring the factitious assistance of the domestic fire-irons in order that it may be handled without defilement.

Assuming, as I justly may, that I am addressing mainly those who have taken, are taking, or will take, considerable part in the administration of India, or, at least, are conversant with its leading features, I may begin by clearing to some extent the air by the admission, in which most of us will concur, that the taking of a census is an unmitigated nuisance to all concerned in it. It is a serious addition to the almost annually growing burden of district supervision. It dislocates, for a considerable time, the ordinary work of the town or village staff of officials; it withdraws from the none too numerous body of district officers several whom the local governments can ill spare; and last, but not least, it throws upon the Olympians at head-quarters the responsibility and labour of finding answers to a budget of totally new conundrums. From another point of view, too, the lot of the officer in charge of the operations is not, any more than the policeman's, a happy one. He is no man's child; the imposer of tales of strawless bricks upon the districts, and the breakwater of the secretariat against the waves of importunate inquirers. Like his ancestors in this country, the barbarians drive him to the sea and the sea beats him back to the barbarians. He fulminates summer lightning, lambent but innocuous until it passes through the transformer of the Government to which he is temporarily attached, in but not of it, as a sort of sub-pro-tem. demi-god for a limited time and a still more limited purpose.

In spite of all these unfavourable considerations, however, the work of the census resounds from first to last with the keynote of Indian administration—Efficiency, but efficiency as it is understood out there. The word has been made familiar enough of late years to us here, where the standard is a different one, partaking of a personal character, and never attained whilst the reins are in the hands actually holding them, though absolutely certain of achievement if those reins were entrusted to some one else. In India, the test is the result, and it is on this that I am relying in the matter of the census. In preparing a paper on the more technical aspects of a census, I had recently occasion to look through nearly the whole of the reports on the operations in our colonies for the last few

enumerations, and without in the slighest degree disparaging the work done in some of the larger units of the Empire, I can conscientiously say, without flattery, that the enumeration and subsequent work in India stands well in the very front rank for both expedition and statistical handling. I take but one instance of the former, probably familiar to most of us. The preliminary totalling of a population of more than 294 millions was completed within a fortnight from the taking of the census, and what is still more striking, the results in their finally tested form differed from the initial tabulation by no more than 96,000 persons, or ·03 per cent. This beats out of the field every previous record, and must be considered a triumph of what in India we should call *bandobast*. I may remark in passing, that the system of rapid tabulation and communication of results initiated in 1891, and carried to such perfection by Mr. Risley, has been adopted in countries other than India on our suggestion; and I received some time ago the thanks of the Norwegian Census Officer for introducing the system to the notice of their directing staff when I was over there, and thus facilitating the speedy publication of the results for a population widely scattered over a very difficult country. Now, it is obvious that the very best laid scheme of this sort must "gang a gley" unless the machinery by which it is carried out works without friction or impediment, and it is in this respect that the census work in India is so lucky in having at hand not only the instruments, but the loyalty and good will to make use of them. I refer not merely to the official classes, but to the co-operation of others who have always come forward to place their intelligence and education at the disposal of the State for the purposes of the enumeration. Whilst the brunt of the effort must, of course, be borne by the officials, with whom rests the whole responsibility for the local arrangements, there can be no doubt of the great help rendered by others, especially those of local influence, in anticipation of the census, and of the literate minority in the actual operation, in tactful exhortation and careful appreciation of their duties. In fine, where this co-operation can be secured, and where the village system with its staff of officers is well established, this difficult operation is carried out in a way that need fear comparison with no other country, East or West. It is unnecessary for me to dwell upon the economy of the arrangements thus effected, as I can only go upon the figures of ten years ago, but from the returns of the provincial officers hitherto published, there seems no doubt that the cost is less than before, and even then it was far below that of any country where the same amount of information is collected from anything like the same population, and on any of the Western scales of expenditure, the census in India would be out of the question.

Considered then, as a mere record of official efficiency, I hold that the Indian census is worthy of our attention. Still more does it commend itself to those who may take up the review of its results in the various provincial reports. Here again the work stands out above the rest of the enumerations with which I am acquainted, from the standpoint of literary merit alone, apart from its more technical quality. The men who write these reviews are not specialists in statistical learning. Often they begin their intimacy with such subjects during the lull that follows the preliminary organisation and precedes the storm of enumeration. But they have all been accustomed to handle facts with the view of setting them forth fully and clearly for the information or decision of others. They have the necessary literary training, and, in most cases, I am happy to find, the equally necessary saving grace of humour, which saves them from any resentment of stupidity, against which the gods themselves, says Schiller, fight in vain. Their daily experience, again, in court and village, gives them a genial appreciation of the mental attitude of the masses in regard to what is to the latter a perfectly irrational and unintelligible proceeding. I do not deny that the reports in question are somewhat long, if not prolix. This, as a late Secretary of State for India told me, is, he thought, the "badge of all our tribe."

After all, the amount of history and detail put into the report depends upon the degree of ignorance which the reporter assumes to be characteristic of his probable reader; and in questions such as those of religion and caste or language, the special character of each province has to be taken into account and cannot be ignored or passed over. It might be possible in cases where the, so to speak, permanent factors of such subjects have been adequately treated in a previous report, to refer the reader to the back number. Unfortunately, it is not every library that keeps a complete set of census records, nor is it quite in accordance with human nature to assume that one cannot say what has been said before,

with much more point and grace. I think, therefore, that we shall always have to reckon with the "origins," so long as caste, language, and religion form part of the census record, and it is for the reader to keep his head amidst the whirl of new facts and new doctrines which emanate on each occasion from the altars raised to the great god Anthropology. He will be sure to find lots of good reading on his way through, for the ethnographic element is one of the most prominent in the census I am reviewing. Not only is Mr. Risley an enthusiast in this study, and one of the best known authorities upon the anthropology of the east of India, but the question of mother-tongue, always a difficult part of the subject in India, has been taken up by an equally distinguished philologist, Dr. Grierson, in connection with the enterprise of which he is at the head, the Linguistic Survey of that country, embracing an inquiry into the distribution and origin of all the tongues current, or reputed to be current, from the Himalayas to the Dravidian frontier. I only wish I had had the benefit of his co-operation ten years ago, when it fell to my lot to ordain a scheme of classification of the hundreds of local titles under which mother-tongue was returned in the schedules of that enumeration. The classified Index prepared in anticipation of the census of 1901, must have afforded incalculable relief to those who had to struggle with the numerous entries of dialects specified by mere caste names or the name of some small geographical area of a distant province, or even by some fancy title that occurred to the householder when safe *in partibus*. Such a work must be admittedly tentative to some extent, pending the full and final evidence collected in the different localities, but even as it stands, it is a great advance on anything on record on previous occasions, and is conclusive evidence that the tradition of research, so well illustrated among former generations of Indian Civil Servants, is still adequately maintained. It is outside the scope of this paper to enter into the details of so wide a subject, still more to discuss points on which there remain extant some reason for difference of opinion, but, at all events, the author of the work must be congratulated upon the links he has established between tongues hitherto considered to be unconnected, and upon the rehabilitation of the title Mundarian, in the room of the usurper of its throne, Kolarian, now placed *en disponibilité*.

Whilst the prescription of a form of classification of an ethnographic feature like language is not only legitimate but enlightening, I am very doubtful whether, in the circumstances of the Indian population as it exists in the present day, a similar course is to be commended in the case of social distinctions like caste. For the practical purposes of compilation some conventional system is obviously essential, but it must be only on the very broadest lines. Any attempt to take into consideration other than the most apparent and superficial facts entails confusion and consequently failure to attain the object of the scheme. It is impossible to avoid begging some important question in any classification on a single basis, while any other scheme results in cross-grouping and misconception. The superintendent of the Bombay provincial operations pithily sums up the results of divergent tests as resembling a proposal to group the inhabitants of an English county under the heads of (1) barristers; (2) members of the Church of England; (3) families of Norman descent; and (4) residents in the county of Middlesex.

The scheme of classification officially put forward on the present occasion comprised five divisions; first, the representatives of the three twice-born castes of tradition; second, classes allied to the above, either by tradition or by virtue of their profession; third, those other than the second from whom the Brahman may take water; fourth, those from whom he cannot accept that convenience; and fifthly, those whose touch is impure. I venture to think that with the exception of the last group, and the Brahman and Rajput castes of the first group, there is no serious difference in opinion among experts in the subject which is not involved in this scheme, and the application of it to existing facts, where it has been adopted, so far as the reports have reached me, appear to confirm this view. In Madras, the classification of the Hindu community along with the Animistic forest tribes, has been on linguistic grounds, with a geographical index, an expedient which, however it may serve local purposes, does not appear to me to materially further the compilation of the Imperial table on the subject.

Ethnic origin is taken into account in one of the main groups of the Bombay scheme, on evidence admittedly open to question, whilst the central group of the "mixed castes" is admittedly overgrown, and, therefore, useless for further classification. Admitting that a return of caste is necessary periodically—I do

not say every decade—and despairing of obtaining any general result satisfactory from an ethnographic standpoint, I am inclined to look only to the practical or administrative side of the question, leaving all else to the local gazetteer or the ethnographic survey now, I believe, in progress under Mr. Risley's able superintendence, but independent of the census. With this in view, I hold, as I held of yore, that the best guide, in all but a few notorious exceptions, to the social status of the caste of the mass of the Brahmanic population, is the eponymous function or occupation, by geographical or linguistic groups. I see that in a good many cases confusion reigns even amongst the census officers, between the function in question and the occupation actually followed by the individual or the caste in the present day. The two are completely distinct and often have no connection with each other, but the social position is that indicated by the traditional title of the caste. Nor, to remove a further misconception, am I in any way an adherent of the theory of Mr. Nesfield, as to the functional basis of caste. On the contrary, I much prefer the wider view of Mr. Risley, supplemented by the acute and suggestive line taken by M. Senart, but I am not concerned here with evolution or development, but with what is before us at the time the census photographed for us the people of India in March, 1901.

Setting ethnography on one side, I fear the picture placed before us is in many ways a sad one. I have had to do, in my time in different capacities, with four enumerations in India, the second of which, when I was in charge of the provincial operations, took note of the great famine of Southern India in 1876-77. The fourth, in which my active participation was confined to the provision of a memorandum of suggestions, is still more markedly the record of the effects of plague, pestilence, and famine, over a far wider area, and at a shorter interval from the enumeration. As the census taken, in 1872, in the province where I was serving was the first of its kind, and more or less tentative, I have only the record of 1891, which I can call that of India under its normal conditions, undisturbed, that is, by famine or special ravages of disease. It is to this period we may look, therefore, for some indication of a standard by which we can measure the abnormal features of the ensuing census. I do not propose to do more than make use of the minimum number of figures that will serve to illustrate the main points that are prominent on the face of the returns. I have not, in the first place, the complete tables before me, nor the reports from the three large provinces of Bengal, the Punjab, and the United Provinces, which contain between them more than half the population of the whole country. I am dealing, therefore, with the general returns already published, and with the details of those provinces only the complete results for which have been received here.

Now, taking the growth in population between 1881 and 1891, the rate of just under 11 per cent. is about what might be expected to prevail in an old established civilisation consisting mainly of agriculturists, and not materially reinforced by immigration from outside. It stands between that of the United Kingdom and that found for the last twenty years in Canada. We are thus able in a measure to appreciate the check imposed upon the accretion of population by the late distress, a matter which in former times was impossible. Instead of an increase to the amount just mentioned, we have one of $1\frac{1}{2}$ per cent. only, not taking into account, of course, the territory brought under enumeration for the first time in 1901. There is, moreover, a very important distinction between the two rates which does not appear on the surface of the returns, namely, that whereas in 1891 the rate of 10·96 was the combination of one of $11\frac{1}{2}$ per cent. over nearly 95 per cent. of the whole, with a decline of 2·4 per cent. in the remaining 5 per cent. in 1901, only 63·3 per cent. shows an increase, and that at the lower rate of $8\frac{3}{4}$ per cent., whilst the remaining 37·7 per cent. fell off in number in the proportion of 10·9 per cent. I may perhaps explain that in the above calculation the unit of compilation is the district or state, divided into the two categories of those in which the population increased or decreased respectively, in whatever small proportion. The variation in the distribution indicates most painfully the comparatively large area that suffered from the recent famines. This difference is accentuated by a cross-division according to political status. In the territory under direct administration, one-third of the local population showed a falling off, whilst in the States, many of the largest of which fell within the famine zone, the decline ranged over no less than 53 per cent. The rate of decrease, moreover, was lighter in the affected portion of British territory, being 6·4 per cent. as compared with 19·6 in the States. The net result is, that the

provinces, as a whole, show the small increase of 3·87 per cent., and the States a decrease to the extent of 6·3 per cent.

Glancing cursorily down the different units contributing to the totals I have just mentioned, it seems that the mean rate for the provinces between 1881 and 1891, viz., 9·7, was reached in the ensuing decade by Burma and Sindh alone, where, in round numbers, the increase amounted to 20 and 12 per cent. respectively. Madras and the Punjab return 7 per cent., Assam 6, and Bengal just under 5 per cent. The decrease in the Central Provinces was 8 per cent., in Berar 5, and in Bombay 4. Ajmer suffered with the surrounding States, though less severely, as the difference between the 12 per cent. loss it shows in the tables, and the 19 per cent. given for Rajputana, may be in part attributable to immigration from the latter to the former. The highest rates of loss in district areas, so far as my information extends, are, in Bombay, 18 per cent.; the Central Provinces, 20; Berar, 12; Madras, 6½: the Bundelkhand group in the United Provinces declined by some 10½ per cent. In the States the rates are far heavier. I find 42 per cent. in Bundi; 36 in Jesalmer; 40 in Mewar; 30 in Bikanir; 38 in the Mahi group under Bombay, where, as in Mewar, the hill tribes suffered severely, while Baroda, as a whole, decreased by 19 per cent., and the Central Indian group by over 17.

In the distribution of functions in India, with which we are familiar, the town plays a part insignificant as compared with the importance of urban life in Western Europe or our colonies. But on the approach of famine there is always the inclination on the part of the lower classes to betake themselves to the nearest large centre of population. Thus it happens that the urban aggregate does not on this occasion indicate a falling off like the surrounding rural tracts. It is true the increase appears to be no more than 9 per cent., but, in the last enumeration, under normal conditions, it was no more than 9½, and then, too, as now, it seemed to be based more on the growth of the smaller units than upon the development of the larger cities, other than the seaports.

The cities of the plain, even in the midst of famine, show for the most part an increase. I can name among them Nagpur, Ahmadabad, Surat, Agra, Haidrabad in the Dekkan, Ajmer, Indore, Jabalpur, and several others of less note. Baroda lost nearly 11 per cent., against 19 per cent. in the State as a whole; and Jaipur, only saved itself from a fall by reinforcements of the fair sex. Even Poona, afflicted by plague as well as surrounded by scarcity, fell off by under 5 per cent. Bombay (the report on which city I can recommend, especially the historical volume), with a decline of 6 per cent., attributes a death roll of no less than 114,000 to the plague, a calculation which would indicate a growth of about 8 per cent. had this mortality not occurred. In these circumstances, as a Bombay duck and a patriot, I beg to defer judgment on the 24 per cent. increase in Calcutta, until I get the details. The City of Palaces has shrewd methods with its suburbs which have to be carefully watched from the other side of the punkha. Of the other large cities of India, not already mentioned, Lucknow continues to lose ground like its neighbour, Faizabad, and Patna, its former compeer in provincial fame. Mandalay and Benares also have fallen off. The proportion of the urban population to the total has doubtless risen in the decade, but this is a fact of little value, since the change must be due in great measure to the depletion of the rural tracts rather than to the increase in the towns.

There is a feature worthy of note in regard to the variation in the component elements of the population of the large towns, that while in almost all of the great seaports, except Bombay and Karachi, the ratio of females tends to decrease, as one might expect, the reverse has been the case since 1891 in the great towns of the interior. This is in harmony with the general tendency throughout the country, especially in the famine zones, and, indeed, with experience over a much wider field than India affords. There seems to be, and here I speak merely on conjecture based on recent examination of a large number of the census returns of different countries, an inclination for the weaker sex to increase relatively faster than the other in some proportion to a rise in the standard of life. As circumstances grow easier the vitality of women seem to increase. Conversely, and of this we have abundant evidence in India from the census, it is the women who bear the stress of famine better than men. Looking down a table I prepared for another purpose, I noted that in every one of the groups of decreased population, with the exception of the small Bengal States which fell off, the loss of the fair sex is markedly less than that of the men, the difference being almost proportional, so to speak, to the intensity of the distress.

Without going into detail, I will take the general result, which was, in the case of British provinces, or rather the portion of them showing decrease, the loss of 7·2 per cent. of males, and 5½ per cent. of the other sex, and in the corresponding areas under the States, of 20½ per cent. of the one, against 18·6 of the others. The tendency, however, does not appear where the area increased in its population, except in some of the larger groups of States, where men may have temporarily left their women folk behind when seeking work, but both increasing and decreasing tracts, provinces and States, taken together, show the same result as the former enumerations, that is, a slight increase in the proportion of women, and mostly due, as above shown, to the smaller loss of women in the famine tracts.

Another fact of considerable value brought out in the returns is the effect of famine upon the distribution of the population by age. Naturally, those who suffer most are the physically weak, who are found at the beginning and the end of life, and every return I have had the opportunity of examining tells the same tale of relative decrease in the number of the old and of those who have not reached their sixth year. The difference, here, again, is proportional to the intensity of the stress of the period of scarcity. Taking the male children only, in Rajputana their ratio to the total fell from 13·4 to 8·8 per cent. In Baroda the corresponding figures were 13·2 to 9·6; in Berar, 13·1 to 10; Bombay, 14 to 11, and so on. In Sindh and the Panjab the ratio has always been unusually high, but while the former has maintained its position at 16 per cent., the latter has apparently descended from that figure to 12½. The normal, I may mention, in North-Western Europe, is about 12¾ per cent., but this assumes a slower rate of increase than we have to count upon in the tropics, where, also, improved sanitation and medical attendance help to keep the proportion on the up-grade, until, of course, the stage is reached where, as in this country, in the colonies, and even in the United States, an improved infantile life is counteracted by a marked decline in fertility.

I must leave, however, subjects that are at best dry and technical, merely calling attention to their general bearing upon the stock-taking of the people which is the function the census has to perform. There is but one other point as to which I shall appeal on this occasion to figures, and that is the relative variation in the numbers professing the main religions of India. I have selected this rather than that of migration, which I had originally intended to take as my final text, partly because I found the latter subject required collation of more details than I had at hand, and the tap of information has been to some extent turned off, so to speak, since one of those comprehensive turns of the official wheel of fortune swept Mr. Risley from his post at the head of the census to more honourable duties. Partly again, there has been, I understand, some correspondence in the newspapers about the relative growth of the professors of Christianity and those of Islam, a matter involving some careful dissection of the returns in order that the figures for the two enumerations may be susceptible of accurate comparison. I have done my best to attain this result, and I think the figures I now quote may be received with confidence.

The Brahmanic community, which numbered 72⅓ per cent. of the population in 1891, has been reduced by the small fraction of 40 per 10,000. The wild tribes adhering to their primitive forms of worship, show a decline of 10½ per cent., partly because they were severely visited by famine in much of their hills and forests, partly by reason of absorption into Brahmanism. They are always a doubtful factor in the returns. Then we come to the Buddhists, who, owing mainly to the rapid growth of population in Burma, show an increase of over 19 per cent., and count as nearly 3 per cent. of the total. The Jains have gone back by nearly 6 per cent. a change attributable in part, I should say, to the famine in Rajputana and Gujarat, and to a small extent, possibly, to reversion to Brahmanism, a tendency I noticed ten years ago. The Sikhs have increased by just under 15 per cent., the Parsis by 4½, a trifle below the rate in the preceding decade. This low rate is remarkable in a community so well-to-do as that of the Zoroastrians of Western India, and it is worth investigating. The small Jewish communities hold their own with 6 per cent. There remain the two communities to which I referred above. Islam has increased by 7·6 per cent., and bears now a proportion of 21 per cent. on the total, as compared with 20 in 1891. Those returning Christianity as their creed have increased by 27¾ per cent., the highest rate in the record, and constitute within a fraction, one per cent. of the whole population. The question was, I believe, raised whether the growth of this last religion was due in some measure to an accretion of

children, taken into orphanages and similar protective institutions during the famine. I have examined the age-returns, accordingly, and on comparing those of 1901, with those of ten years before, I can trace what I may term slight, but well-marked inflation of the numbers at the ages between 5 and 15, when, against the general rate of increase I have just quoted, there is a rate of 39 per cent., viz., of 34 between 5 and 10, and 45 at the next quinquennial period. This may or may not have been due to the special cause alleged. At all events, after eliminating all tracts enumerated for the first time in 1901, the relative growth of the Christians is nearly four times that of the Mussulmans.

I have now touched upon most of the subjects which can be brought within the compass of a paper such as this, and I can only hope that I have succeeded in my attempt to show that a census, especially a census of India, is not altogether devoid of human interest, and is not confined to the knocking about of unwieldy masses of doubtful statistics. My theme suffers, of course, from its survey being confined to a part only of the whole field to be covered, and I have been obliged to substitute mere gleanings for a general review, but it has been a pleasure to me to have been obliged by this undertaking to read over so much that everywhere recalls pleasant reminiscences of localities, people, and incidents, connected with a period of my life upon which I always look back with the deepest interest, and with unfailing gratitude for the numberless opportunities it afforded me of both study and action.

DISCUSSION.

The Chairman said that, in the few remarks he had to make, he spoke only as one who had occasionally visited India, and not as one who had spent a good part of his life in that vast country. But he, like all who had been there, felt the greatest nterest in that land and its people. He quite believed all that had been said by Mr. Baines about the Indian officials, and he was sure that the statements which had been made about the compilation of the census applied equally to the other work of that department of the Civil Service, that it was done with remarkable efficiency and economy. In the case of Mr. Baines's paper, the work had been done almost with second sight, even if not with absolute foresight, because for his (Sir Robert Mowbray's) part, he had not been able to obtain the general report of the census of India, as he understood it had not yet been published as a whole, though masses of local figures had. He thought the great point brought out by the paper was the unity in diversity of the Indian Empire, a point which ought to be brought home to the people of this country, and especially, perhaps, to those who would be going out to India. It was the custom at home to speak of India and its people as if it were a whole, as one community. And he was not quite sure that some, when they went globe-trotting, and procured a native servant who could talk Hindustani to save the traveller trouble, might not be imbued with the idea that India was a land of one language. The present paper served the useful purpose for those who did not know India of bringing out the enormous variety of languages and religions existing in the land. He would have been glad to have heard the author's views on migration; it would have been interesting to know how far the people of the thickly-populated districts showed a tendency to migrate to the less thickly-peopled areas, because one often heard people talk of population of India as if it were not only immense, but dense all over. As a matter of fact, some parts were very densely populated, but others very sparsely so. To those who thought of the future of that Empire, one of the most interesting questions was as to whether there was any likelihood of relief to the districts which threatened to become congested by migration to other parts. Mr. Baines had shown that there was a larger falling off of population in the Native States than in the British provinces, and he would like to hear from the author in his reply whether he attributed that mainly to the intensity of the famine, because it had been shown that in many Native States the famine was very intense. How far was that difference attributable to the relative intensity of the famine in the two districts, and how far to better administration? Such points were interesting to those whose business it was to learn, and not to express views on India which were based upon only a limited experience. The present paper was technical and precise, and it was a good opportunity to learn from those who had made the matter a lifelong study.

Sir Steuart Bayley, K.C.S.I., C.I.E., thought Mr. Baines could be congratulated on the fact that he was not, like his colleague, unwilling to touch the subject of the census again, even without the pair of tongs to which he had referred. He wished Mr. Baines had had the advantage of seeing the reports of the other provinces. He (the speaker) had seen, only yesterday, the report for the province of Bengal. It was a thick volume, and the work had been done by Mr. Gait, and would have given Mr. Baines many points for discussion in the paper. As bearing on the question of organisation Mr. Gait mentions that at Patna, and the districts surrounding, when the enumeration was being taken, plague broke out and raged at its worst, and there was a general demoralisation, and many of the enumerators themselves died, while others fled, carrying with them the

papers. So bad was it that the city of Patna had to be counted again later. It was satisfactory that the missing information was replaced with the greatest rapidity, and with extreme care. The author referred to the question whether it was necessary to repeat the reports about castes and ethnology on every occasion. Possibly that need not be done, but it was intensely interesting. Such a report as that of Mr. Ibbetson on the Punjab was one of the most useful and fundamental works on the ethnology of those parts of Northern India which could be obtained. Though such information did not properly belong to the census, the latter could not be necessarily understood unless some such foundation were included. It had been shown that the women seemed able to withstand the effects of the famine better than the men, and that they appeared to have better chance of life in towns. The latter was to be expected as life is easier there, but he had not come across any information which threw light upon the first point in the Bengal report; it had, however, occurred to him, that those who stood the famine worst were those who were most given to wandering. Women remaining in their villages were more likely to be quickly reached by relief agencies. They were, therefore, more likely to survive the hardship than the men, who were only reached after prolonged wandering. He very much wished the author had been able to turn his attention to the question of migration. With regard to the distribution of population in different parts, Mr. Gait had shown that there was not a tendency for the people in the over-populated districts to go into those very sparsely peopled, with plenty of waste land, except for such special purposes as that of the Assam tea gardens. The tendency was to migrate towards the middle-class districts, where the population was fairly thick. Mr. Gait showed that although the percentage of increase by migration was very much larger in thinly populated districts, yet the actual numerical increase in the thickly-populated districts was greater. Another point in the paper was the increase in the apparent number of Jains, and their tendency to be absorbed in Hinduism. But he thought it was a fact which Mr. Gait bears out, that the Jains did not acknowledge that they were not Hindus, and very often they entered themselves as Hindus in the census papers, especially in Bengal, where they were surrounded by a Hindu population. The Bengal report also referred to the increase among the Mohammedans. Mr. Gait stated it was not a temporary phenomenon, but the Mohammedans were more fertile than the Hindus, and gave two explanations of it. One of the causes stated was that they had a more nourishing diet; and, secondly, that their widows generally re-married, and the age of marriage was later. Those tendencies had increased recently, because there had been a great deal of preaching on the part of the Mohammedan mullahs against the Hinduising tendencies of their people, one of which was to prohibit widow re-marriage. Reference was also made by Mr. Gait to the large increase in the Christian population in Bengal. He showed, what most people acquainted with India were aware of, that in Bengal, at all events, the increase was not from Hinduism, or from Mohammedanism, but almost entirely from the wild tribes who were classified in the census paper as animistic. The same gentleman had explained in reference to the Nagpur district, where the increase is very marked indeed, that 12 or 14 years ago there was a good deal of political agitation, the aboriginal cultivators having risen against their landlords who were aliens, Hindus from Behar. In those quarrels missionaries interfered, and took the side of the cultivators; and the cultivators, thinking they secured an advantage by it, were at one time brought over in large numbers. This was, however, only a very small item in the whole movement, which was mainly owing to great religious activity in Chotia Nagpur, were at the head-quarters, Ranchee, there were some four missionary agencies of different denominations competing in the work, and as was well known their success was greatest among the animistic tribes.

Mr. T. W. Holderness, C.S.I., said he desired to associate himself with the last speaker in his acknowledgments of the excellent and interesting paper which had been presented by Mr. Baines. That gentleman had shown that the dismal operation called the census, which was supposed to be the product of an equally dismal science, that of political economy, was full of interest. He (Mr. Holderness) would submit only one observation, namely, in regard to the growth of the population. The author had pointed out that in the census of India in 1891 the population increased during the decade by 11 per cent. In the present census, as far as he remembered, in British India there had been an increase of about 4 per cent., while in the Native States there had been a decrease. Mr. Baines then said he thought the census of 1891 revealed a sort of normal increase in the population, an increase which ought to be expected in future. The author thought the rate of increase was half-way between that of England and that of Canada. He (Mr. Holderness), agreed that the present census figures showed the effects of the famine, which was writ large over the figures, but he thought it a mistake to suppose that 11 per cent. in the decade would be a normal increase in the population, such as should be expected in future. He thought a perusal of the figures of the decade ending with the census of 1891, would show that the decade was not only a prosperous one, but also represented the rebound of the population after the desolation of the great Indian famine of 1876 to 1878. The figures of the 1891 census showed an enormous increase in Madras and Bombay, and further increase in other areas which had been affected. Therefore, even in 1891 he thought the 11 per cent. did not represent the normal increase. With regard to Bengal, Mr. Gait had endeavoured to trace a connection between the rate of growth of the

population of the different districts, and the effect where such scarcity had existed, but that gentleman had not been able to find any. He also showed that by examining the age figures of the census, the smaller growth of population in Bengal had been occasioned, not by increased mortality, but by a decreased number of births. From that it was argued that ordinary preventive checks were in operation in Bengal, on account of the density of the population, and that as long as it remained dense there must be a slacking off in the growth of the population. The same applied, he thought, in the United Provinces. The growth of the population in the decade ending 1891 was 6 per cent., but that did not fulfil Mr. Baines's 11 per cent., and there was no famine during that time. In the present census it had fallen down to 2 per cent. One might measure the intensity of that famine by the difference between 11 per cent. and 2 per cent.; but really it was the difference between 6 per cent. and 2 per cent. With regard to the problem why women appeared to suffer less from famine than men, he had occasion to investigate that matter during the famine, and heard various theories put forward. One was that the men wandered more, as had been already mentioned that evening, and that the women had charge of the food and did the cooking. Famine food was very rough and disagreeable, and required to be cooked with care. Where there was a family the man shared in the benefit of the cooking, but where the men were by themselves they had no one to cook for them.

Sir William Lee-Warner, K.C.S.I., said the excellence of the subject under discussion was that it gave rise to many trains of thought. The Chairman had alluded to the feature of unity in diversity, and he (Sir William) thought the Roman Empire, in its brightest days, never dreamt of any Government being able to carry out an enumeration on the scale which had been accomplished in the case of the Indian Empire. That task was not only one of computing numbers, it involved also classifying them so as to arrive at definite conclusions. One point of view had not been presented, one, however, which he hoped would furnish occasion for another paper, namely, the romance of Indian administration. The whole of the census was a glorious romance from beginning to end. It would be interesting to hear how, in each successive census, the prejudices which had to be at first encountered had been swept away, and how rare it was now to learn of the scenes of bloodshed which originally were not uncommon when the census people went to work. Again, what an interesting chapter of Indian history could be evolved from the numbers of stories which were at one time circulated, and were still, whenever census-takers appeared in a district! It would show the progressive extension of education. The extra work thrown on the officials at the time of the census was not all loss, because the experience thus gained was very valuable for all time afterwards. The bare counting of numbers was sometimes a romance. He remembered an adjutant of a regiment coming to stay with him, who said, "There is something I wanted to ask you: what is a Brahmin?" He answered him, and was then asked, "Is he different from a Mohammedan? The camp followers brought a return and asked me to fill it up for their camp followers and women, and I put them all down as Brahmins!" If that were at all typical he wondered how far the falling off in the figures relating to Hindus was due to better calculation and computation. Again, there was the romance of the theories which one was tempted to indulge in when the figures were before one. Was the falling off of the numbers in Native States contiguous to British States due to want of care on the part of the Native State in meeting the famine, or to an idea among the people that there was such want of care? Such changes were largely due to migration, but that was not always attributable to neglect on the part of the Government; it might be due to an impression of better administration in a contiguous State, or to the people not knowing what measures of relief their own rulers proposed to take. As to hasty inference he remembered reading in Buckle's "Civilisation" that the reason the Hindus committed so many murders was that they were accustomed to eat a very heating food, to wit, rice. But when he got to India he found that where crime was more rampant than elsewhere the people ate no rice. With regard to the rate of conversion of the people to Christianity, he would relate an anecdote about that also, as it would shed light on the statistics. After the great Dekhan famine a sweeper woman entered his employ. He at once discerned that she did not belong to the ordinary sweeper class. After about a year's service she suddenly disappeared, and it transpired the woman had gone off with somebody else, in order that she might embrace the Mohammedan religion during the absence of her husband, who had gone away to one of the frontier wars. She originally belonged to a very good caste indeed. When the Government broke up their establishments and sent back the children to their homes, they asked the distant relatives of this girl and her two sisters to take charge of them, but they declined to do so, because they said they had lost caste by having eaten food in the relief camps. They were, therefore, outcasted and thrown on the world, and the women were taken as sweepers. Thus a famine in such cases led to a change of religion other than the Christian, an influence which seems to have escaped the attention of the census commissioner.

Mr. J. D. Rees, C.S.I., said one had no reason for saying there was any normal rate of increase for India. He thought the truth of Mr. Holderness's remarks was borne out by a study of the history as well as of famine records, and we should not be depressed because a certain rate of increase was not

maintained. The population did not advance at any exceptionally rapid rate. The author of the paper had said that the men who wrote the reviews of the census returns were not specialists in statistical learning. He (Mr. Rees) had been through every provincial report on the census which had come to England, and wished to express his admiration for them, for had the officers who wrote them been engaged in that kind of work all their lives he did not think they could have furnished more admirable reports; and he urged that they should not leave out in any decade the interesting chapters dealing with ethnology. With regard to the heavier mortality in Native States compared with British territory, he thought that did show that the relief was better administered in the latter than in the former; and it was on record from the lips of the minister of one of the great Native States that the mortality was greater there on account of too severe a land tax. That was a very important point, and it was also pleasant to see criticisms of a certain class refuted by an authoritative document like the census returns. With regard to the women suffering less from f mine than the men, he thought the reason was that the men continued to work while they were in poor health, while the women did not, at least not to the same extent. With regard to the increase in the number of people in India who professed Christianity, he had read the reports, and the census superintendents distinctly said that the increase of 27 per cent. was due to the famine, and directly so. With regard to migration, he did not think there were many congested districts in India. The migration within the country, which went on from Bengal to Assam, was not sufficient to have any great effect, and the Government evidently did not value it very greatly because the effect of the last Act, passed in connection with the movement, had been to almost put an end to it. The Chairman in his remarks did not claim any intimate acquaintance with India, but he (Mr. Rees) reminded the audience that Sir R. Mowbray had been there three times to his knowledge, on one of which occasions he went as a member of the Opium Commission, the very sound and sensible report of which must have commended itself to all interested in India.

Sir CHARLES CECIL STEVENS, K.C.S.I., remarked that the reader of the paper had noticed his approval of the statement that a census was an unmitigated nuisance to all concerned. No one who had not gone through it could conceive how true this is of an Indian District Officer. In India we attempt to do a great deal with a very small establishment; hence all extra work—the taking of a census or the management of a famine—devolves on a District Officer and his subordinates. Mr. Baines had also glanced at the present speaker as he was uttering his good-natured sarcasms respecting the population of Calcutta, which now apparently is recorded as larger than that of Bombay. "Calcutta" used to be the technical name for the area within the Mahratta Ditch, the population of which was computed at 450,000. He (Sir Charles Stevens) was once Chairman of the Suburban Municipality, separated only by the road which now occupies the site of the ditch, containing 250,000 more; besides this, were the contiguous north suburban and south suburban municipalities, not to speak of the great suburb of Howrah, only just across the river. Calcutta was no more represented by the old area than London is by the City. He had not seen the Bengal report, and was not, therefore, aware what exact areas have been included in Calcutta now; he believed the total was about 1,150,000; if Bombay now, for the first time, stand second, it must be remembered that it should not have stood first before. In considering the results of a census, he would lay stress on the fact that the figures represent only the conditions existing at the present time when the census is taken, and not necessarily the normal conditions. For instance, at the first formal census, he was in charge of the Nadiya District. Just when the census was being taken, a considerable number of the people were in the Sunderbunds, assisting to get in the rice harvest; so that the Nadiya figures were too low. Another example of a temporary migration is that of coolies from Chotia Nagpore to the tea gardens under the Himalayas, and of others from the same locality to Calcutta. These persons return to their homes with their gains. Other accidental causes might affect a census. For example, near the end of 1897 a severe cyclone swept the low islands in the north-east of the Bay of Bengal as well as the alluvial tract on the main land opposite them, causing a total loss of about 14,500 lives. Such a calamity as this would vitiate the conclusions drawn from the figures of the district, and would even affect the provincial districts of the year. In comparing the rates of increase and decrease from census to census, the speaker suggested that regard should be had to probable deficiencies in the earlier attempts at numbering the people. The work was novel and its extent gigantic, and it would certainly not be surprising if here and there it was imperfect. Sir Charles Stevens desired, in conclusion, to add his thanks for the able and interesting paper which had been read.

Mr. MARTIN WOOD thought it very desirable that students of social and vital statistics here should be able to read what the ceusus of the Indian population means. Then, too, Mr. Baines's paper was of practical value in showing the effectiveness of the administration of India which was so effective mainly because the people of the country were so largely employed on it. Those who remembered the first census on the modern plan, that of 1871, would be struck by the very large extension of the methods, and the greater precision with which the recent returns had been made. But he thought there was a danger in Mr. Baines's paper of attempting too much of that refinement and precision. Ethnology was an interesting subject, but its tendency was to mix up the question of caste.

The vote of thanks to the reader of the paper was carried unanimously.

Mr. BAINES, in acknowledging the vote of thanks, said that it was only due to those who had so courteously discussed his paper that some explanation should be offered on the main points raised. He had a somewhat higher opinion than Sir William Lee-Warner of the efficiency of the Roman census, because that operation was intimately bound up with taxation, and thus had that special interest for the provincial governments which was equally carefully kept apart from the census in India. Nor could he accept the opinion of Mr. Rees that the Indian system was Procrustean, a term which implied undue straining after uniformity, since the sole aim of the central authority was to secure comparability of the general data, with elasticity in matters noted for special local features. In regard to the advisability of retaining in each report a certain quantity of ethnological matter, he would explain that all he wanted to omit was the discussion of origins and development, which appertain, in his opinion, rather to the survey of ethnography as a whole, than to a report on a contemporary state of affairs, like a census. He held few works in higher estimation than Sir Denzil Ibbetson's report on the Punjab census of 1881, but its very scope and excellence made a successor on the same lines superfluous. He also congratulated the Bengal Government, and, latterly, the Government of India, on having secured the services of Mr. Gait, whose work on Assam, in 1891, was of the first class, both as to statistics and ethnography. He had not yet received a copy of the Bengal report, but the points raised by Sir Steuart Bayley in connection with it were treated, to some extent, in previous works on that province, which showed most surprising diversities, as, for example, between Eastern Bengal and Bihar in the matter of infant and widow marriage. The question as to whether the Jains considered themselves a sect of Hindus or a separate creed depended upon local circumstances. Where the Jains are scarce and not influential, they preferred to be merged in the denomination of the majority. Elsewhere, however, they carefully avoid inclusion under the head Brahmanic, whatever they may think of the meaningless term Hindu. In the remarks made in the paper about Calcutta, the author only implied that the limits of the metropolis were indefinite, and it might so be that in earlier censuses suburban districts were excluded which were incorporated on subsequent occasions. This could not occur in the case of Bombay. It was worthy of note that in Australia, where the chief cities were growing less at the core than in the suburbs, the metropolitan area included all tracts within a radius of ten miles of the centre, whether municipal or rural. Three important statistical questions had been raised, that of migration, by the Chairman; that of sex distribution, and that of the general rate of increase of the population. The first he would have dealt with in his paper had the full returns been available, because it was not only of the greatest importance in India, but also one of much interest statistically. There were three kinds of migration in India, differentiated, generally speaking, by the proportion of the two sexes involved. Colonisation, as we understand it in the West, meaning the movement of a community in its full life, is found only in the Punjab, and, perhaps a few tracts in Assam and the Central Provinces, since in no other parts of the country are large contiguous tracts of unoccupied arable land to be found. Where this movement takes place, the women are usually in about the same proportion to the men in the new settlement as they were in the districts of origin. In the second form of migration, the women are in considerably higher proportions than the men hailing from the same locality, and this is due to the habit of frequent intermarriage between the inhabitants of villages on or near the frontier of the district or province. The greater part of the migration found in the census record, is of this class. There remains the temporary migration for a special object, such as trade or seasonal employment. Here the males are vastly predominant; whether the movement be of artisans or Marwadi merchants to the seaports, of coolies to the tea plantations, or of wanderers driven from home by famine to seek such relief work as may commend itself to them. The information at present available does not suffice to justify an opinion as to whether the immigration during the famine into British districts, from Native States, was abnormal or not. The data examined in connection with the paper, gave no firm ground for believing that there was much change in the flow since 1891, and this is not improbable, because the British territory, contiguous to the most distressed States, was itself in unhappy plight, a fact which induced the authorities to keep a strict watch on the component parts of their relief gangs. Exceptional cases, like that of Ajmer, are no doubt to be found. The second question is, to some extent, involved in that of migration. The proportion of women to men tends to rise, and to rise higher in or after times of famine than in ordinary circumstances. The position taken up in the paper, is that the tendency is for the proportion to rise by birth or survival, as the standard of life rises, but that the rise in the ratio during famine is due almost entirely to the greater enduring-power of women under pressure of hunger. This position has not been disturbed by the suggestions made in the discussion. If more men than women wander from a district in search of work, they will be enumerated in the locality to which they have gone, or, if they die on the way, the statistical result is that set forth. Again, if the women survive because at famine kitchens it is this sex which gets the first grip of the food supply, it connotes the assumption that the young girls get favoured more than the boys, an anomaly in the present general sentiment of Indian society. The theory which commends itself most to

the author, is that whilst women, after middle life, are proverbially tougher than men of the same age, in time of famine, women, being of a far more adipose diathesis (if that be the right phrase), have more to support themselves on in their own frames than the more muscular and less fat-enveloped, "mere men." Finally, there appears to have been some misunderstanding about the normal rate of increase. The term implies simply the absence of extraordinary disturbances, or else, of course, their elimination by counterbalancing influences. A normal rate of growth tends to decrease in a settled population, but only slowly and usually at most ages. In the case of India, the use of a total is simply as a measure of details. The country is composed of so many elements differing greatly from each other, that probably no single unit, whether province, district, or State, is represented by the total. On the other hand, the rapid growth, or recovery, of one part of the country, has its influence in neutralising the effect upon the total of the slow rates that prevail in another. Thus, the examples taken in the discussion were those of the most densely peopled tracts of India, and there, as shown by a somewhat minute analysis given in the report for 1891, the rate of growth is remarkably slow. Again, as India is rarely entirely free from inferior harvests somewhere or other every year, the rebound in the ensuing season comes upon the census record with the falling off of the succeeding year, and it is only when an abnormally wide area has been affected, for a long period, extending to within a short interval of the enumeration, or, of course, where there has been a series of bumper harvests, that the harmonising effect of the large numbers provided by the total for India, does not re-establish a figure which can be fairly called normal for the decade just elapsed, and tending to be equally the rule if applied to similar circumstances before or after that period. He hoped that he had given, if not an answer, at all events, an explanation, in regard to most of the points that had been raised, and he thanked the Chairman and the audience for the consideration that had been shown to him and to his paper.

THIRTEENTH ORDINARY MEETING.

Wednesday, March 4, 1903; The Hon. EDWARD LYULPH STANLEY, M.A., in the chair.

The following candidates were proposed for election as members of the Society:—

Bodington, O.E., 6, Boulevard des Capucines, Paris, France.

Braine, Charles W., 25, Schubert-road, Putney, S.W.

Chetty, V. Alwar, Trichur, Cochin State, India.

Colabawalla, Behramji Muncharji, Aden.

Colabawalla, Nasserwanji Muncharji, Aden.

Eason, Vernon, Francistown, Bechuanaland Protectorate, South Africa.

Freire, Dr. José J. da Silva, Officinas de Engenho de Dentro, Estrada de Ferro Central do Brazil, Rio de Janeiro, Brazil, South America.

Fryer, Tom Jefferson, A.M.I.Mech.E., 20, Change-alley, Sheffield.

Harvey, William J., J.P., 21, Mincing-lane, E.C., and Conservative Club, St. James's-street, S.W.

Jones, C. H., Harley-lodge, Enfield.

Padar, Pestoriji, Cowasji, Aden.

Walsh, Cecil J., 6, Regent's-park-road, Church-end, Finchley, N.

The following candidates were balloted for and duly elected members of the Society: —

Atherton, Rev. William Bernard, B.A., H.M.S. *Urgent*, Port Royal, Jamaica, and Taynton-house, Taynton, near Gloucester.

Blaize, Hon. R. B., Lagos, West Africa.

Brickwell, Alfred James, Great Northern Railway, Surveyors' Department, King's-cross Station, N.

Darby, William Evans, LL.D,, 47, New Broad-street, E.C.

Dennes, Donald, M.Inst.M.M., The Gold Coast Proprietary Mines, Limited, Accra, Gold Coast Colony, West Africa.

Kelly, William Lamb, care of British India Steam Navigation Company, Calcutta.

Krawehl, A., Anchor Brewery, North End, Port Elizabeth, Cape Colony, South Africa.

Leven and Melville, Earl of, Glenferness, Dunphail, N.B., and Roehampton - house, Roehampton, S.W.

Maclennan, John Donald, M.Can.Soc.C.E., 527, Garfield-building, Cleveland, Ohio, U.S.A.

Pidgin, Charles Felton, Gray-chambers, 20, Mount Vernon-street, Boston, Massachusetts, U.S.A.

Ruxton, Captain U. Fitz H., The Residency, Yola, Northern Nigeria, West Africa.

Stodart, Edward Herbert, 59, Barrow-road, Streatham-common, S.W.

Wheeler, Frederick, F.R.I.B.A., 6, Staple-inn, W.C.

Williams, John Norman Spencer, M.I.Mech.E., Hawaiian Commercial and Sugar Company, Kahului, Maui, Hawaiian Islands.

The paper read was—

EDUCATION IN THE NETHERLANDS.

By J. C. Medd.

At this time of transition and experiment, when the whole organisation of education is in process of reconstruction, the comparative study of different systems has a special interest. Each country must still solve its own problems for itself, for the value of every system ultimately depends upon the extent to which it reflects national character and satisfies national needs. This is a truism, but some people have been perhaps a little inclined to imagine that a system adapted to, and successful under, the particular social and political circumstances of another nation can be reproduced in England. From types of schools and methods of instruction more is to be learnt than from the details of administrative machinery. The range of inquiry, therefore, should be as wide as possible, and the selection of foreign products essentially eclectic. Of late, Holland has been comparatively neglected. Since Matthew Arnold's Report to the Commission of 1861, and Kay Shuttleworth's "Four Periods of Public Education" in 1862, nothing of importance has appeared here upon the subject, except Mr. Reginald Balfour's excellent historical survey of the causes which led to the legislation of 1889, and his analysis of the laws relating to primary instruction. The Dutch system, however, may well claim attention. A system may be, as in Germany, mainly the creation of the State, or it may be a natural growth, and the visible expression of public opinion. The latter is pre-eminently the case in Holland. Private initiative was the motive power: the function of the State has been to supervise and stimulate local effort. This is the English attitude, and in other respects no nation presents so many points of similarity. The two peoples are distinguished by the same practical commonsense, the same spirit of independence, and the same distrust of bureaucratic interference. In addition, the constant necessity of grappling with the forces of nature, due to the physical conditions of their country, has created in the Dutch a steadfastness of purpose in every department of life, which is not always observable in England. To this concentration of aim and determination not to be baffled by difficulties, they owe the fact that their education has for a century excited the admiration of Europe, and that reverence for it is so widely diffused through every class in the community. Any detailed examination of the system would be impossible now: this paper must be confined to a few of its more distinctive features.

Primary Education.

The modern period of Dutch national education really commences in 1806, when the State undertook the supervision and direction of public instruction. The ground had been prepared by the Society for Promoting the Public Welfare, which, for some twenty years, had been agitating for better schools and more effective organisation. The Act of 1806 will always be noteworthy from having established the thorough system of inspection, to which the subsequent excellence of the primary schools is to be attributed.

In the words of Matthew Arnold:—

"To keep the system of inspection efficient was the central thought, the paramount aim of Van der Ende, the author of the Act, to the very last days of his life, when he received M. Cousin, at Haarlem, in 1836, and said to him, 'Take care how you choose your inspectors; these are the men whom you ought to look for with a lantern in your hand.' And inspection in Holland was organised with a force and completeness which it has attained nowhere else."

None but schools, "neutral" in the matter of religion, as were those established by the above society, were officially recognised; children were to be prepared at school for the practice of all virtues, Christian and social, but dogmatic teaching was forbidden, nor was any interference with the religious convictions of pupils of different denominations permitted. The ministers of the various communions, however, were offered the use of the schoolrooms for religious instruction out of school hours, and the time-tables to-day occasionally set apart an hour during which the school houses are at the disposal of the clergy, under certain conditions. In practice, this arrangement did not satisfy the clerical party any more than does the similar provision in the Australasian colonies. The Government reserved to itself the right to refuse the establishment of any primary school without its express authorisation. When this power was exercised to prevent the foundation of private denominational schools, discontent was inevitably aroused; and the interpretation of the word "Christian" became the battle-field for endless controversy. The "neutral" schools were attacked from many differing standpoints; amendments to the Act and various concessions were from time to time introduced,

notably in 1857 and in 1878, but the struggle continued until 1889. This is not the occasion on which to discuss the advantages or otherwise of the Dual System. It is enough to say that the Government were ultimately compelled in that year to admit the justice of the demand that the State Treasury, which was open to the "neutral" school, should be opened for the denominational schools also. To both categories of schools State-aid is now given. The public schools are financed partly by the State, partly by the commune, and partly from fees. If the fees average £6 13s. 4d. per annum per pupil, the State contributes nothing. Apart from this, its grants amount to 25 per cent. of the capital outlay on building and the purchase of land, 25 per cent. of the cost of maintenance, and from 6 to 10 per cent. of the teachers' salaries. The latter grant is based upon a fixed scale, determined by the size of the school, ranging from £36 to £55 in the case of head teachers, and from £12 10s. to £16 13s. 4d. in the case of assistants. Additional aid is given to those schools in which, owing to their size, one or more of the assistant teachers must possess the qualifications of a head teacher, and where two at least of the optional subjects, French, German, or English are included in the curriculum. Government grants are paid quarterly, and in advance, to the Communal Council, by the Minister of the Interior, upon receipt of a statement from the "Deputation," *i.e.*, the permanent committee appointed from among the members of the "Provincial States" to act as the local authority for each Province, setting forth the number of scholars, the subjects taught, the number of teachers legally required, and the number actually employed, and the amount of grant due. Nothing is stated as to methods of instruction, results attained, qualifications of teachers, the condition of the pupils, the educational requirements of the district, or the needs of the school. The Government relies wholly upon its inspectors to administer the system locally, upon the teachers to perform their duties, and upon the communes properly to apply the funds on behalf of the schools. Public interest in and respect for education are assumed to be sufficiently strong to justify this, although pressure from the central authority might apparently, with advantage, be brought to bear upon some of the rural communes.

The regulations as to the size and character of school buildings are enforced by the Public Health Officers, not by the education authorities. Either the buildings are condemned, in which case the school is closed until new buildings are erected or alterations are made, or else the fact that the school is open is taken as proof that the buildings are suitable, and that the sanitary arrangements, &c., are satisfactory. The communes, which must see that the supply of schools is adequate, and must afford to those parents who prefer a public school facilities for obtaining places in one, are responsible for (*a*) the teachers' salaries, (*b*) board-allowance, where there is no rent-free house for the teachers, (*c*) subsidies for the training of teachers, (*d*) the provision of continuation schools, (*e*) the cost of building, maintaining, and purchasing land for school and teachers' houses, (*f*) lighting, warming and cleaning the school premises, (*g*) the cost of school furniture and apparatus, (*h*) the cost of the local inspection and of the organization of the meetings of the inspectors, and (*i*) the cost of school libraries, prizes and diplomas.

Special Government grants are occasionally made, where a commune cannot, out of its own resources from school fees, local rates, and ordinary Government grants, meet the necessary expenditure. Instances are not unknown, in which these special grants have amounted to 50 per cent. of the total expenditure. The number of public schools in 1900 was 3,096, with 503,731 children upon the books. It was estimated in that year that the percentage of children of school age not upon the books of any school, public or private, was about 8½.

The managers of private primary schools receive grants from the State towards the expense of maintenance and teachers' salaries, upon the same scale as the public schools, provided the school is under the management of an institution or some responsible society; has not less than 25 pupils above 6 years of age in attendance; gives at least 18 hours' instruction per week in the obligatory subjects, of which not more than 2 hours are devoted to needlework; is not conducted for profit; and does not charge fees amounting on the average to £6 13s. 4d. or more per annum. The State makes no contribution towards the cost of building, nor does it grant any special subsidy to schools unable to meet their annual expenditure. Grants are, however, now given by the State towards the maintenance of the fabrics and apparatus, from £3 6s. 8d. to £46 8s. 4d. per annum, according to the size of the school and subject to certain conditions. The communes are forbidden to render any assistance, except rewards for

regular attendance, and Mr. Moyersoen, writing in 1894, states that it would be considered illegal for a commune even to admit private school scholars to any special school of manual or other instruction which it might have established.

By the Act of 1878 the communes were permitted to subsidise private schools, if they surrendered their denominational connection, but very little advantage was taken of this, and in 1898 there were only 17 private schools in receipt of this communal aid. The number of private schools increased from 1,244 in 1890 to 1,448 in 1900, and the number of pupils from 187,576 to 226,957. The financial position of these schools can hardly be regarded as satisfactory, and, although there has been considerable improvement since 1900, they do not as a whole attain to the level of the public schools.

The Act of 1889 made fees, of not less than 4d. a month, obligatory for all pupils, except the poor, and I have the authority of Baron Mackay, who was Minister of the Interior at the time, for stating that this was purposely done to prevent the public schools from competing unfairly with the private schools by giving free education. The scale of fees is fixed by the Communal Council as the local education authority, but certificates of exemption or reduction of the amount to be paid are granted by the Burgomaster and Aldermen acting independently. This practice of remitting or lowering fees in the case of the poor is universal in every grade of school, and does not appear to cast any reflection upon either the parents or their children. There is something to be said in favour of making the non-payment of fees an exception, for people usually value more that for which they pay, and, when attendance was made compulsory in 1900, the Dutch did not consider that free education was the necessary corollary.

The duration of school life is from the seventh to the fourteenth year. The State does not concern itself with the organisation of infant schools, or grant certificates for their teachers. They are left to the care of private societies and the municipal authorities of large towns; the latter have undertaken the work of organisation on their own account, and have established special colleges for training teachers. Probably the best of these is that at Leyden. To meet the demand for child-labour in the rural districts at certain seasons the local inspectors may "grant a temporary exemption from attendance at school on behalf of work in or for the occupation of agriculture, horticulture, tending cattle, &c., to children, who in the last six months preceding the application have regularly attended school, for not more than six weeks annually, exclusive of the vacations." A child is considered to have attended regularly who for two consecutive months has not been absent on more than two occasions without reasonable cause. This provision serves a double purpose: it removes the objection of farmers and parents to the loss of a child's services, when work on the land is most pressing, and it operates as a direct incentive to regular attendance. There are no half-time schools, and this temporary exemption granted to children for definite employment is in every way preferable to closing a school without any guarantee that the scholars will be engaged in any useful occupation. A child must be at least 10 years of age before it can obtain leave of absence, and there must be substantial reasons for every application. The privilege is widely appreciated, and the inspectors report that its effect has been extremely good. A similar concession might be tried here: in Holland it has certainly improved the attendance and conciliated the agriculturists. As a rule attendance throughout the country leaves little to be desired: in the towns it is rare to find any child absent without due cause, and the general average for urban schools is about 95 per cent. In the villages it varies a good deal: for the most part the inspectors do not appear to have much cause for complaint, but in some cases they do not look for any improvement until the law is made more stringent.

Beyond the subjects, which must "as a rule" be taken in all English primary schools, geography, the history of Holland, and Nature-study (*Kennis der Natuur*) are everywhere obligatory. While this is an undoubted advantage, the course of instruction in optional subjects is far more restricted than in our Code. Little scope is afforded for making the instruction suitable to the circumstances of the children and the neighbourhood, and hitherto the effort to make the curriculum less exclusively literary has met with considerable opposition. The introduction of needlework for girls in 1889 was the first recognition of any practical teaching. It is true that so long ago as 1806 the Legislature expressed a wish that practical subjects might be taught, but permissive laws rarely have much force, and this re-

mained a dead letter. The conviction, however, is rapidly growing that the primary school must be brought into closer correspondence with the actual needs of the people, and that hand and eye training are essential elements in all education, and the Government has already taken steps to facilitate the desired reforms. The principal obstacles have been disinclination to move out of old grooves, the question of expense, complaint on the part of teachers that their time-tables are full, and a natural disinclination to attempt subjects for which they are not qualified. Happily these difficulties have been removed with us, and it is questionable whether any system of elementary education is based upon more truly educational principles than those of England and Scotland to-day, with their abundant elasticity and capacity for expansion. The fullest opportunity is afforded for the adaptation of means to ends, and the character of the work done in the majority of the primary schools of the United Kingdom is probably unequalled, and certainly not surpassed in any country. Have we not, perhaps, been unduly apt to disparage our own schools?

In regard to methods of instruction, it may be said of the Dutch schools, as it was by Cuvier, that they are "beyond all praise." Although the choice of subjects is somewhat limited, teachers enjoy the widest latitude in method. Their ingenuity in devising new methods is remarkable, and no visitor to the Hague should omit to see the clever way in which Nature, commerce, industry, and social life are connected with all the lessons at Mr. Ligthart's school in Tulling Straat, one of the poorer districts. The teachers generally are enthusiastic: they infuse "mind" and intelligence into every lesson; there is no ladling out of dull unrelated facts. The individuality of each child is apparently studied, and he is made to find out instead of merely being told about things. All the instruction proceeds, as it ought to do, from the known to the unknown. In geography, for instance, lessons commence with the school, then the street in which the school is situated, then the town, the province, the whole country, and so on, to Europe and beyond, each stage being illustrated with maps drawn by the children themselves. The same plan, so far as is practicable, is adopted in history, the children being taken to places of historical interest. Similarly visits to notable buildings, museums, and factories, are of frequent occurrence.

Few things in recent years have been more striking than the development in Nature-study. It is taught universally in schools of every grade, urban and rural, for its great educational value in developing certain faculties, especially those of observation, quite apart from its value as a preparation for science, or in its possible relation to rural pursuits. Last year at the Botanic Gardens many of our primary and secondary schools showed excellent work in this subject, and it is unnecessary to seek for models elsewhere. But what is somewhat exceptional here, is, in Holland, the customary mode of instruction. Text-books are seldom used. Plants and flowers, gathered by the children themselves, are studied objectively, and their structure explained. Their life and history are illustrated from plants grown in bottles, pots, and boxes, in water, sand, sterile and fertile soil. The effects on growth of light, air, warmth, and moisture are demonstrated. Insects are reared in breeding cages. The school yard is often provided with two or three deciduous and evergreen trees, under each of which in turn the children have lessons on their differing formation and properties. Small plots of ground are usually cultivated with little patches of cereals, vegetables, and flowers, not for the sake of the produce, but to illustrate as great a variety of plant-life as possible. School-gardening, as we understand it, is not taught, and the tendency at some of our schools to teach gardening without any relation to the rest of the curriculum is not to be encouraged. The subject, of course, has its value under any circumstances, as a form of physical exercise, and as a means for imparting some dexterity of hand and eye, but technical instruction in horticulture, while appropriate to the continuation school, is out of place in the day school. The true function of the garden at the latter is to supplement and illustrate the other class lessons, with which the work out of doors ought to be carefully co-ordinated.

The standard of primary education in the rural districts is by no means uniform. In the Netherlands, as elsewhere, the quality of each school depends upon the character, capacity, and sympathy of the teacher, and the public spirit of the local authorities. Indisposition to increase the rates, not hostility to education in itself, has here and there to be encountered. No attempt has yet been made to meet the difficulties irreparable from small isolated schools in scattered neighbourhoods by the plan recently introduced with so much success in

Ontario, the State of New York, and one or two of the Western States. There a few townships are grouped, and the most conveniently situated school, to which the children of the district are daily conveyed, is enlarged, so as to supply the wants of a wide area. This ensures better attendance, better buildings and equipment, and a better staff, while it is more economical than the maintenance of distinct and struggling schools. Posssibly, an experiment of this kind might be usefully tried in England, the foundation managers of the central school being of the same denomination as those of the schools, which it replaced. Nor have any of the admirable *écoles primaires supérieures* of France yet been established, a type of school which we should do well to imitate.

Under the Compulsory Education Act, 1900, a continuation school must be organised in each commune for those who have received the usual primary instruction. The school must be open for at least 96 hours in the year, and the curriculum must include at least four subjects, of which two at least must be selected from those comprised in the day-school course. Opportunities must also be afforded for girls, whether they take part in the lessons with boys or not, to receive continuation school instruction for 96 hours in the year apart from the hours in the evening. The classes for girls can only be held on two half-days in the week, and must commence before 5 p.m., unless otherwise specially permitted. In the rural districts it is a mistake to expect that girls and young women can or will be allowed to attend classes except in the afternoon. This compulsory provision of instruction beyond the day-school compares very favourably with our *laisser faire* attitude, which permits whole districts to be absolutely destitute of any education or training for lads and girls at the most impressionable period of their lives, and when their characters are being formed for good or evil. At any rate, a continuation school ought to be within reach of every child in the country. When the Act was under discussion, it was proposed that attendance should be obligatory until the age of fourteen, but this was defeated. The schools are generally open from October to March, and the age of the scholars is from thirteen to sixteen. The curriculum, which need not be, as the name *herhaling* would imply, simply a repetition of the day-school work, is determined by the Communal Council, the head teacher, and the district inspector with due regard to local requirements. The inspectors are using their influence to make the instruction practical, and cookery and housewifery are now commonly taught in the urban continuation schools for girls.

The proportion of teachers to pupils in public primary schools and their qualifications are fixed by law. Two certificates are granted, the one, for which candidates must be 23 years of age, entitles the holder to act as a head-teacher, the other as an assistant. If a school has more than 40 and less than 91 pupils, there must be one assistant; if more than 91 and less than 145, two, the proportion afterwards being one assistant for every 55 pupils. This minimum may, however, be exceeded, if the commune believe it to be in the interest of education. In schools requiring three assistants one of them at least must possess the higher certificate; in schools with more than seven assistants two of them must be so qualified. The exact status and salary of assistants possessed of the higher certificate has never been exactly determined, and their position is not altogether satisfactory. Since 1884, 600 has been the maximum number of pupils allowed in public schools; for private schools there is no limit, provided that it exceed 25. No mixed public school may be under a headmistress, and in 1900 there were only 63 headmistresses of public girls' schools. Co-education has been the invariable practice in every grade of school from the earliest times, and separate public primary schools for the two sexes are extremely rare. No probationer, pupil teacher, or "young woman approved by the inspector," counts upon the school staff, and it is unfortunate that, when we imported the pupil-teacher system from Holland, we did not also import the regulation, which forbids a pupil-teacher to give any instruction except under the supervision of a member of the staff, a rule which is always strictly enforced. Salaries are fixed by the communal authority, but must not be less than £58 6s. 8d. per annum, together with a house or lodging allowance, for head teachers: £50 for assistants with the higher certificates, and £41 13s. 4d. for other assistants. These were the minimums in 1900, but I believe they have been recently raised. Government pensions, not exceeding two-thirds of the salary received during the preceding twelve months, and of the estimated rental value of the teacher's house or of his lodging allowance, are paid to public school teachers of 65 years of age, and to those incapacitated by illness after ten

years' service. Towards the pension fund teachers contribute 2 per cent. of their total income.

The Training of Teachers.

There are six State training colleges for males, and one for female students. The municipalities of Amsterdam, Leyden, and Groningen have provided their own colleges, of which the two former are open to both males and females, and the last to females only. In addition, there are 19 private training colleges, of which 12 are the property of different religious denominations. The course of instruction is for four years. Students are admitted after examination to the State colleges at the age of 14 or 15, but must not be above 18. In these colleges none of the students live upon the premises. Suitable lodgings are found for them, the State supplies all books, &c., and pays for the board and lodgings of those whose relatives do not live in the town, to the amount of about £25 a year. The scheme of studies is drawn up by the director and staff. It varies slightly at different colleges, mainly in the time devoted to particular subjects. "Nature-study" is taught everywhere; agriculture and horticulture only at Nijmegen, Middelburg, and Haarlem.

At the last-named there is also manual instruction. The whole syllabus there is admirably adapted to qualify teachers to give effective hand and eye training. In wood work, for instance, each student makes a complete set of the models of the Swedish Slöjd system. They also make objects required for other lessons, such as chisels, rules, levers, and scales; models of tools or engines to assist in explaining different trades and industries; implements for the manufacture of linen and lace, and churns. Each student, moreover, constructs an aquarium, a terrarium, and a case for insects to be collected and attended to by himself. All the models are first drawn by the students, either full size or to scale. The aim of this instruction is (1) to provide an efficacious means for satisfying the need of physical exercise; (2) to train the eye and the hand, and to form habits of accuracy; (3) to lay, by methods of intuition, the foundations of the mathematical sciences and their applications; (4) to teach the students how to make the apparatus required for object-lessons in primary schools, and (5) to qualify them to give manual instruction themselves. As yet the State gives no certificate for this subject, but most of the students at Haarlem pass the examination and gain the certificate of a private Slöjd Association.

Special diplomas (an elementary and an advanced one) are offered by the State for proficiency in agriculture and horticulture. Students prepare for these, either by following the courses prescribed by the National Agricultural College at Wageningen, and conducted in each province by the State Professor of Agriculture, or by private study. Horticulture is taught, both theoretically and practically, at the training colleges. The practical work consists in the cultivation of small gardens, and is extremely popular. Everyone learns by doing, and Nature-study may be applied in gardening, and countless other directions.

On this ground it will be a matter for regret, if the regulations recently issued by Mr. Morant, for the next examination of our students, are not so modified as to admit of some regard being paid to other than mere book-work. These regulations as drafted will necessitate a return to the worst form of text-book cramming, and are contrary to the whole spirit of the recommendations of Mr. Hobhouse's Departmental Committee, and of the specimen courses of instruction drawn up by the Board of Education itself. In Holland it has never been suggested that the training of rural teachers should be differentiated from that of urban teachers. Usually the students go first to a village school, and then move on into the towns, where the salaries are higher.

Attached to every college is a practising school, all the expenses of which are defrayed by the Government, and in which fourth-year students are engaged for 24 hours a week. For students, not at any training college, courses of instruction are provided by State normal classes, private tuition, and by classes under the headmasters of primary schools. In each case the syllabus must be approved by the Minister of the Interior.

Secondary or Intermediate Education.

By the law of 1863 every town with a population of 10,000 must establish both a day and an evening burgher school. These schools were intended for future artisans and labourers, but it was found that young lads of the working classes could not attend school in the daytime, and the day schools have entirely disappeared. The Act, however, has not been repealed, and the obligation to provide a day school, if the population be as stated, still holds good,

unless there are other opportunities for education. The communes, therefore, have to apply to the Government every five years to be exempted from erecting new schools. To satisfy the law, higher burgher schools have been founded in every instance, and in some towns where the population is not above seven or eight thousand. At first the artisans fought shy of the evening burgher schools, but the growing appreciation of the benefits of education has completely overcome their prejudice. The present Inspector of Trade Schools, Mr. de Groot, when Director of the Burgher School at Alkmaar, raised the number of pupils from 28 to 246 within four years. There has been a corresponding development elsewhere, due to the simplification of the programme, and its extension over a longer period. The curriculum is arranged by the local authorities, upon whom falls the whole cost of maintaining the schools. The classes are usually held from October to September, and the instruction is mainly theoretical in such subjects as mathematics, natural history, elementary mechanics, physics and chemistry, Dutch and drawing. The drawing is applied to particular industries, and at three of the schools there is some little practical and technical instruction bearing upon certain trades. Frequently no fees are charged; elsewhere they range from 3s. 4d. to 10s. per annum, the maximum under the Act being 20s. No difficulty is ever experienced in obtaining free places. Pupils are admitted at the age of 12 or 13 after an examination in the obligatory subjects of the primary school, unless a recommendation from the school teacher is considered sufficient. Certificates are awarded at the end of the course of three or four years. There is some risk that the continuation schools may clash with the burgher schools, but probably this will be avoided by retaining the more educational character of the latter and making the former more practical. In the rural districts the difficulty, of course, will not arise.

The higher burgher schools, referred to above, are the voluntary creation of the different communes. The law of 1863 merely defined their curriculum, and prescribed that they should have courses of three or five years' duration. Contrary to general expectation, the longer period has proved the more popular, and is the rule at 54 of the 77 higher burgher schools now in operation. After the passing of the Act, the State established a number of "model" schools, of which it to-day entirely controls and finances twenty-one. The fees vary from £2 10s. to £5 a year, but free places are always obtainable. There are no scholarships or bursaries, and the clever children of poor people in the rural districts must find it difficult to climb the so-called "educational ladder." Girls were first admitted in 1871. In towns with no separate school for girls they may enter upon the same terms as boys; where there is such a school, they must obtain special permission from the Ministry of the Interior, and be working for the higher branches of education. The usual age of admission is 12 or 13, after an entrance examination. At the end of the course, diplomas, the examination for which is decidedly severe, are awarded; these entitle the pupil to proceed to the Polytechnic at Delft, or to one of the Universities to study medicine or natural science. To enable the pupil to attend theology, law, or literary classes at the University, a supplementary examination in Greek and Latin must be passed. The curriculum is exclusively modern and embraces some twenty subjects, including mechanics, physics, chemistry, biology, political economy, book-keeping, English, French, and German. It was originally thought that the syllabus for the first three years might be the same in both types of school, but it was soon realised that this was an impossibility. Each school was then made to present a scheme of instruction complete in itself, and to fulfill, in its degree, a definite function. The point deserves notice, since a suggestion similar to the original Dutch design has recently been thrown out in the consideration of modern secondary schools for England.

There is a feeling that too much is attempted in schools with the longer course, and that the programme is overladen. Unfortunately, the framers of official programmes are invariably more anxious not to omit anything, which can possibly be included, than to suggest what can be thoroughly assimilated within a given time. In Holland, the pressure is aggravated from the fact that boys have to learn three instead of two foreign languages. Complaint has also been made that the instruction is too theoretical, and there is a danger there, as elsewhere, that the demand for technical and practical subjects may act prejudicially upon general education, which is the necessary antecedent to all successful specialisation. The equipment of the schools is superb. In fact, the lavish manner in which schools of every description, except some of the rural primary schools, are furnished with

the most modern and expensive apparatus and models testifies to the ungrudging spirit with which the State and the municipalities alike regard the claims of education. No teacher can justly say that he is hampered by the lack of appropriate material.

In many respects the schools resemble the *Realschulen* of Prussia, which, however, were founded some 17 years later. They suggest just the type of school which is so sorely needed here, a school which provides a really sound and liberal education upon modern lines up to the age of 17 or 18. The commercial and industrial advance of other nations is due, apart from economic causes, less to the superiority of their technical training than to the thorough and wide knowledge, obtained in their secondary schools, which qualifies students to turn the subsequent opportunities for acquiring technical skill to the best possible account.

The Government has nothing to do with the establishment of higher burgher schools for girls. Formerly State subsidies were given, but these have now been altogether withdrawn, not from any parsimony on the part of the State, but owing to the extreme liberality of the municipalities. The schools are, however, subject to Goverment inspection, and their situation is officially described in the Annual Report. Each school is free to determine its own curriculum, which usually includes mathematics, physics, chemistry, natural history, history, geography, Dutch, French, German, needlework, drawing, and gymnastics. The fees range from £4 3s. 4d. to as much as £33 6s. 8d. at the Amsterdam private school. The course is invariably one of five years, except at Deventer. For the final examination diplomas or certificates are awarded. These have no intrinsic value; they do not admit either to the Polytechnic at Delft, where there are generally a few lady students, or to the Universities. If a girl intends to proceed to the University, she will require two years' private tuition in Latin and Greek to enable her to pass the State entrance examination. This is felt to be a grievance, and perhaps constitutes the weakest side of girls' secondary schools. A proposal has been made that pupils in the fifth class at school should be placed in two divisions, the first of which would consist of those who did not wish to matriculate and would follow the ordinary curriculum, while the second composed of University candidates, would learn Latin and Greek, and remain a sixth year at school. This change has been influentially supported, and there does not appear to be any reasonable objection to it. It cannot be effected, however, without the authorisation of the Government.

During recent years the impression has become very prevalent in Holland that there is ground for fearing that the present system of higher education for girls tends to make young women disparage household duties and consider them inferior to intellectual pursuits. An attempt is made in some schools to counteract this tendency by making the instruction bear upon domestic matters, and by directing the minds of the pupils towards the responsibilities which await them as wives and mothers, but domestic science has not yet been introduced in any practical form. The readjustment of time-tables may present some difficulty, but the difficulty will not be insuperable, when the relative value of different subjects is more fully appreciated, and when it is universally realised that education should take in the whole of life and not be restricted only to its intellectual aspects. Nor is there any reason why domestic science, though taught practically, should not serve a directly educational purpose and not a purely utilitarian one. In this connection it was gratifying at the late Conference of Teachers in Manchester to hear Miss Burstall, the headmistress of the Girls' High School there, warmly advocate the remodelling of the curriculum so as to bring it into closer relationship to the special sphere of woman's activities. And the experiment now being made at the James Alleyne's School for Girls, Dulwich, through the enterprise and liberality of the London County Council, is full of encouragement, and will be watched with the keenest interest.

Higher Education.

Every town, with a population of 20,000 must, in accordance with the Act of 1876, provide a gymnasium, unless specially relieved from the obligation on the ground of poverty, or because, as at Tilburg, the children, being mostly Catholics, attend private schools. The affairs of each gymnasium are managed by a college of curators, nominated by the Municipal Council. The appointment of teachers, upon the recommendation of the curators and the advice of the inspector, and their dismissal also rest with the Municipal Council, which fixes the rate of their salaries, subject to the approval of the Minister of the Interior. All teachers, except those for modern languages, must posses the degree of doctor for that subject, in which they are to give instruction.

It may be remarked, that no one in Holland is permitted to teach at any school without official sanction. The scale of the fees which, as a rule, range from £5 to £8 6s. 4d., is determined by the local authority, but the minimum for the lowest class must not exceed £8 6s. 8d. per annum, and no pupil is to pay more than the actual average cost of a pupil in the same class. The difference in the fees payable is regulated by the income of the parent, as ascertained by the amount of his income tax. There are no scholarships or bursarsies, and but a comparatively small number of free pupils. No boarders are taken, and little seems to be done to foster any organic public school life. Few of the schools have playgrounds, and clubs or associations of past students are not formed. Since there are no girls' schools of a corresponding grade, girls are admitted equally with boys, with the exception of two towns, where the Catholics, who dislike co-education, are in a large majority. The final examination, at which diplomas admitting to the Universities are granted, is conducted by the staff of each school, under the supervision of three Government delegates, of whom the inspector is usually one. The curriculum, which covers six years, is the same for all schools, and includes Latin, Greek, Dutch literature, English, French, German, history, geography, mathematics, physics, chemistry, and natural history. No class may contain more than 24 pupils: above that number they must be taken in two divisions. In Classes V. and VI. there is a bifurcation: pupils preparing for theology, law, and philosophy, form one group; those preparing for mathematics, medicine and physics, the other. The former devote more time to philological subjects, the latter to science. This arrangement does not give satisfaction. It dislocates the work of the school considerably, and several of the headmasters are of opinion that the science teaching is poor and inadequate. The question is hotly discussed whether a classical education ought still to be held indispensable for all who aspire to the highest culture, or whether it must be more or less sacrificed to the exigencies of modern science and society, By introducing the bifurcation the Legislature has tried to conciliate both views, and the compromise is not a success. As a preparation for the scientific side of university life, the higher burgher schools would appear to satisfy all requirements. At the same time, the demand in Holland that every well-educated person should know French, German and English, has already encroached to an appreciable extent upon the old classical tradition.

The Universities of the Netherlands have at several periods and in many ways rendered great service to the intellectual development of Europe, but their organisation does not call for special notice here.

Technical Instruction.

The admirable *ambachts*, or trade day schools, are due entirely to local or private initiative. The first was established at Amsterdam, in 1861, and they now number twenty. They have always been subject to Government supervision, but a special inspector was not appointed for them until four years ago. Their present popularity is such that proportionately they receive more State aid than the secondary schools. In addition to the regular Government subsidy, a special grant is made to the sparsely-populated province of Drenthe, where it has been found preferable to apprentice promising lads to competent workmen, rather than to found a distinct school. This plan was originated by a local society for the advancement of education, and has answered remarkably well.

The course at the schools usually covers three years, and is continuous throughout the year. The scheme of studies naturally depends, to some extent, upon the industrial character of the district, but as a rule it includes drawing, geometrical drawing, physics, mathematics, mechanics, and wood and metal work, all taught technically and in relation to particular trades. In some cases, instruction is also provided in masonry, furniture and instrument making, painting and house decoration. The results are, undoubtedly, excellent. For a short time artisans were somewhat jealous of the trade instruction, but to-day there is an increasing demand amongst them for boys who have completed the school course. It is intended that pupils should come direct from the primary school, and this is the general custom. A few occasionally attend after leaving the higher burgher schools or the gymnasia. At three towns no fees are charged; elsewhere they vary from 8s. 4d. to 16s. 8d. per annum, but free places may always be had. All apparatus is found, and prizes are at times given, but on the whole it is considered inexpedient to encourage excessive competition. Those who follow the entire course almost always receive gifts of apparatus on leaving.

The total income of the twenty schools from private and public sources amounted in 1900 to

£27,497 15s. The school at Arnhem may be taken as a fair example of what is done in a town of moderate size. The number of scholars in 1901 was 322, distributed as follows:—140 smiths, 95 carpenters, 37 furniture-makers, 32 painters, and 18 masons. The instruction is given daily from 8 a.m. till 12, and from 2 to 6 p.m., except on Saturday, when there is a half-holiday. Wide-spread interest is evidently taken in the school, to judge from the numerous gifts of money and appliances to improve the instruction. An annual exhibition of the work is held in March, much of this is permanently on view, and many of the specimens, especially in furniture and decorative art, are first-rate, both in quality and design.

Corresponding to the trade schools for boys are the industrial schools for girls, which also originated through private influence. Although they were only brought under Government inspection in 1899, they received State-aid before the boys' schools. In both cases, an ample guarantee of adequate local support out of the communal poll tax, and the provincial personal tax, must be forthcoming before the State makes any subsidy. For the girls' schools, it is now rightly made a further condition that, in addition to the day classes, they must provide evening classes for those engaged in domestic service, shops or factories. The general aim of the school is to give a girl such a training as to qualify her to become a capable housewife or successful industrial worker.

The course of instruction is for three years, with extra classes for certain subjects, and the schools are open throughout the year. The terms of admission are similar to those at the boys' schools, but the fees are a little more, and the social status of the pupils is rather higher. Frequently, too, young women of 20 or 25 years of age are in attendance. The programme is arranged locally; beyond a continuation of primary school subjects, it usually comprises: — Dressmaking, book-keeping (household accounts), hygiene, first aid, the care of children, the knowledge of wares (their quality and value), and, in some instances, a modern language, laundry work, and cookery. In the cooking lessons care is always taken to employ utensils ordinarily found in the houses of the poor.

One of the most successful of the nine industrial schools now in operation is that at Alkmaar, of which Mevr M. van Reenen-Völter, the Directress, courteously gave me the following description:—

"The students at our school are of very different positions. We have, therefore, three courses: one in the evening for the children of poor people, who are servants during the day. These girls are taught to become good housewives and capable servants. They only pay for the lessons, if they can afford to do so. The lessons take place on four or five evenings a week, for the smaller pupils from 5 to 7, and for the elder ones from 7 to 9 o'clock. They are taught to sew, to mend, to darn, to make their own clothes, cookery, laundry-work and ironing, while we give them some notions of house-sanitation. The second course is for the children of tradesmen, shop-keepers, schoolmasters, the lower ranks of the Civil Service, and superior artisans. This course lasts three years, and has a double aim. In the first place, to form good housewives and mothers; in the second, to teach the young girls one or more branches of industry, art, or science. The lessons are given daily from 9 to 12.30 and from 2 to 4.30. The course is divided into two parts, each of eighteen months. During the first part all the pupils receive the same instruction and the lessons are as follows:—*First six months*: twenty hours a week sewing with the hand, cutting and sewing all the linen necessary for a baby, and knitting, six hours drawing (ornamental), three-and-a-half hours cooking and the chemistry of food, two hours laundry-work, one-and-a-half hours ironing, two hours reading and arithmetic applied to cooking and household matters. *Second six months*: twenty hours a week sewing by hand all the linen for a young girl, darning, mending, and simple embroidery, with other instruction similar to that in the preceding six months. *Third six months*: twenty hours a week sewing with the machine all the linen for a grown-up person, accompanied by the same subjects as before. During this year those who wish it can have lessons in French, English, or German for a very small extra payment. After the above course, the pupils choose what branch of industry, science or art, they will take up, and have a choice of some nineteen different subjects. We take great care to make all this course as practicable as possible. The fees are £2 a year. Our third course is held at the same hours as the second, and is followed by young girls of the upper classes, including the nobility. These pupils pay £3 a year, besides finding all that is required for the lessons, and they choose what instructions they will have from the beginning. The school gets the following aid:—from the State, £416 13s. 4d., from the provinces, £125, and from the municipality, £208 6s. 8d."

The total expenditure in 1900 amounted to £1,057 3s. 4d., but it should be mentioned that Mevr. van Reenen-Völter was at that time generously giving her services. The average cost of each school is roughly about £1,500 a year. In 1900 the number of pupils at Alkmaar was 626—351 in the day and 275 in the evening

school. Of the 351, 119 came from neighbouring towns and villages.

Those who are perplexed by the dearth of competent servants here, or are anxious to learn how the deplorable ignorance of the duties of a wife or mother, which prevails so largely amongst the working classes, may be removed, could not spend a few hours more profitably than in visiting one of these industrial schools. The only effective way of providing efficient training for domestic service or domestic life is by giving a girl, as soon as she leaves the primary school, a *systematic* course of instruction up to the age of 15 or 16 years. Spasmodic and occasional classes can never achieve the same end. The fees normally charged in Holland—about £1 6s. 8d. a year—are not beyond the means of an artisan, and the better wage, which a trained girl of 16 could command, would fully compensate for the original outlay. At the same time, few things would contribute so much to greater comfort in the houses of our artisans and labourers, and to the proper treatment of their young children, than the establishment of at least one of these schools in every urban district. The objection that English girls would be unlikely to attend them is no argument: the opportunity must first be provided. Difficulties had to be faced in Holland, where the experiment has been tried for upwards of 30 years, and has proved an unqualified success.

Of the various schools of domestic science, the Industrial School at Enschedé, and the Polytechnic at Delft, there is no occasion to speak. The organisation of each merits attention, but in these branches of education the study of foreign models is hardly required. It would be wrong, however, to omit all mention of the Commercial School, which was opened at Amsterdam in 1869, and is attached to a higher burgher school with a three years' course. The object is to supply that technical training which is as essential for the distributor as it is for the producer, and which must have a foundation of wide general knowledge, if it is to be efficient. The course lasts two years, and is well adapted for the future merchant or clerk. The value of this specialised instruction, following immediately after the three years in the secondary school, must be superior to what can be given in evening classes, where the lads are often too uneducated to profit by it. There is abundant evidence that this Amsterdam school, like other similar institutions in Holland, has won the confidence of the mercantile community, and it is wholly free from the artificiality of the Business Colleges of the United States. The difficulties, moreover, which are said to have been experienced in connection with the High Commercial School at Leipzig, do not appear to have arisen.

Social Education.

The steps recently taken by a Committee of the Charity Organisation Society to promote instruction in social subjects may justify a passing allusion to the School for Social Work, founded at Amsterdam in 1899. In view of the growing sense of social responsibility, and the desire of so many to engage actively in work amongst the poor, it was felt that opportunities for the systematic study of social and economic problems, both in theory and practice, ought to be provided. By such means alone can the mistakes and disillusionment, which result from well-meaning but uninstructed efforts, be avoided. Zeal, unaccompanied by knowledge, often creates two evils for the one it seeks to cure. The school also trains those who are in need of paid employment in connection with Charity Organisation and kindred societies. The full course, from September 15th to July 1st, extends over two years, and is only open to students of at least 23 years of age. Men and women are admitted equally, the fees being £12 10s. per annum. Lectures upon the laws affecting the daily life of the people, and upon the various branches of political, industrial, and social economy, are given by the best Professors in Amsterdam. The practical work amongst the poor is done under the guidance of experienced leaders. It would be folly to disparage the excellent scheme of the London School of Economics, but it appeals mainly to professed students and future teachers. It hardly touches that large class of philanthropic people who wish to do something to ameliorate the condition of their fellow creatures, but who too often embark upon the attempt without the indispensable equipment of personal experience, skilled training, and accurate knowledge. For this class, lectures alone, however valuable in themselves, are not sufficient. Perhaps it may not be too much to hope that ere long a school upon the lines of that at Amsterdam may be associated with the Oxford-house, Toynbee-hall, the Passmore-Edwards Settlement, or some similar institution.

Finality is not to be looked for in any system of education. The law of evolution is omnipotent there as in other spheres, and periodica

revision will always be required. Considerable reforms are now contemplated in Holland, but their nature has not yet been disclosed by the Government, and it would be fruitless to speculate upon them. The system, however, as sketched this evening, offers many points worthy of our consideration, and they may thus be summarised :—

1. The supervision exercised by the State over all education.

2. The effort to satisfy the demands of the denominationalists.

3. The arrangement for meeting the difficulty in regard to child-labour in the rural districts.

4. The compulsory provision of continuation schools.

5. The admission of girls upon equal terms with boys into schools and colleges of every grade.

6. The establishment of exclusively modern secondary schools in all towns with a population of 10,000.

7. The opportunities open to all boys to obtain technical training in their respective trades.

8. The facilities for girls to acquire a thorough knowledge of household duties and the various branches of women's employment.

9. The specialised commercial instruction linked on to certain secondary schools and provided without any break in the continuity of study.

10. The recognition of the fact that successful social work involves systematic preparation, and the steps taken to supply it.

In conclusion, I would repeat words which I have used elsewhere :—The secret of what the Dutch have accomplished is to be found in their intense earnestness, their sound sense, their indomitable perseverance, and the universal conviction that education is the greatest boon which a Government has to bestow. The result is that the people have attained to a degree of prosperity and comfort which any nation might envy, notwithstanding the present labour difficulties.

DISCUSSION.

The Right Hon. HENRY HOBHOUSE, M.P., said that a great deal of advantage had been gained by the Board of Education having sent Mr. Medd to report first on the educational system of France, and then on that of Holland. There was a great deal to be learned from the experience of other countries, especially from a country like Holland, where the conditions of education and employment were to a large extent the same as here. One important point was the necessity for efficient continuation schools, and he hoped that employers would come to see the necessity for education being continued after young peopte had left school and gone into employment. Another very important point was the "leave of absence" granted in agricultural schools. A clause giving similar powers in this country had been included in Robson's Act, 1899, but it had practically remained a dead letter. He believed that if it had been acted upon a great deal would have been done to conciliate the farmers; but he could quite understand the objection which teachers felt to allowing their students—often their best students—to absent themselves from school. He was quite at one with Mr. Medd with regard to the question of nature study, but thought that it should be made obligatory. But before this could be done it would be necessary to have teachers properly trained to give instruction in science.

Mr. G. H. MORRELL, M.P., referring to that portion of the paper relating to education in agricultural districts, said that we had much to learn from the system adopted in the Netherlands. Our children should be put into the fields to learn from practical experience so long as they were able to show 250 attendances in the year. The great point after all was the training of the teachers. It would be useless to look for any general improvement in rural schools until teachers at the colleges were more familiar with the facts and conditions of rural life. An effort had recently been made to provide more educational training, and he looked forward to the time when the colleges would attach less importance to the acquisition of miscellaneous information than to a complete knowledge of the best methods of instruction.

Mr. THIEME said that, as a Dutchman, he wished to express his thanks for the appreciative manner in which Mr. Medd had spoken of the educational system of his country. He thought that the advantages of that system were manifest. They had, however, one insuperable difficulty, and that was connected with the barges on the canals of Holland. The families of the barge-men were continually moving from commune to commune, and it was impossible to enforce the attendance of the children at schools, as they never remained a sufficient time at one place. Many attempts had been made to get over this difficulty, but hitherto without any success. He thought that there were points highly to be commended in the English secondary schools, more particularly the friendly understanding between teacher and pupil, which nowhere else was so highly developed. He trusted that in any changes which were made this admirable understanding would not be in any way impaired. The cooking classes in the Board schools had also been a great

success, so that fathers often desired their daughters to take over this work in place of the mothers.

Mr. R. MASUJIMA (Tokyo) said that he was specially interested in the information in the paper, on account of its bearing upon the work that had been done in Japan. Their system had been created within the past thirty years, and was mainly due to direct action on the part of the State. As Mr. Medd had pointed out, they had been careful to select from different countries, types of schools most suitable to Japanese requirements, without attempting to adopt the system of any one nation.

Mr. LEON GASTER asked if there was any pension scheme for teachers in connection with the system of Dutch education.

The CHAIRMAN said that he had himself visited Holland about twenty years ago, and had had an opportunity of familiarising himself with the then existing system of education. Many changes, however, took place in twenty years, and Mr. Medd had shown what great progress had been made during that time in Holland. We naturally regarded the systems of other countries as affording lessons for ourselves; and there was a great deal which we might learn from Holland, small as was its population compared with our own. The number of training schools compared with the population was an instance in which we might well copy Holland. Another point was the number and quality of inspectors. The new educational authorities which were now taking over the functions of those recently disestablished would find the necessity for numerous and efficient inspectors—inspectors who had a knowledge and experience of actual teaching. Another point which the new authorities would have to consider, was the supply of teachers. Teachers did not spring ready-made from the ground. The first result would be that the increased demand would raise teachers' pay, but it would not at once create a supply. That was a matter of time. Mr. Medd had referred to the employment of pupil teachers in Holland. The use made of pupil teachers in that country, was the correct one; they served to assist the teacher, not to replace him. The time allowed them for purposes of study and improvement was quite inadequate; they should have more time for learning, and less for teaching. With regard to the question of barge children, the difficulty existed in this country only to a less extent than in Holland. In spite of all the efforts that had been made (and a special Act had been obtained by the exertions of Mr. George Smith of Coalville), it had been found quite impossible to secure that children, who were being carried about from one parish to another, should receive proper education, or indeed any education at all. He had great pleasure in proposing a cordial vote of thanks to Mr. Medd for his admirable paper.

The vote of thanks was carried unanimously.

Mr. MEDD, in answer to Mr. Gaster, said that there was a special arrangement for pensions, which was referred to in a portion of the paper which he had not had time to read. Endorsing the remarks of the Chairman respecting pupil teachers, he said that the excellency of the Dutch primary schools must no doubt be attributed to the fact that no probationer, no pupil teacher, no "young woman approved by an inspector," counts upon the school staff.

Miscellaneous.

SEEDLING SUGAR CANES.

A larger appreciation of seedling canes, that is canes raised from seed as distinct from those propagated by means of cuttings or tops, is becoming apparent in the West Indies. At first seedling canes were regarded with a certain amount of suspicion and it was only under force of circumstances that the planters at Barbados and Antigua took up the cultivation of seedling canes on a large scale. In those islands the Bourbon cane that had been exclusively planted for nearly 100 years had become so susceptible to the attacks of fungus diseases that its further cultivation was impossible. Elsewhere, as in Jamaica, British Guiana and Trinidad the Bourbon cane has not been so seriously attacked by fungus and hence in those colonies the planters except in a few instances, have not been compelled at once to take up seedling canes. They have fortunately, been in a position to discriminate at leisure between the relative merits of seedling and other canes, and to choose those only that promised the best results on a commercial scale.

The results of the very careful and complete experiments carried on for so many years with seedling canes at Barbados, Antiqua and St. Kitt's, and immediately published for the guidance and information of the planting community, have been of great service in these islands. A feature of great importance in regard to these experiments is the fact that the planters themselves having taken so large a share in testing seedling canes on a considerable scale on their own estates. At the present time probably a larger area is under effective cultivation in seedling canes at Barbados, Antigua and St. Kitt's than anywhere else in the tropics. Also the results have been made accessible, not only in detail, in annual folio reports, but also in the summarised pamphlet form wherein the main facts alone are given. In regard to the latter Sir Nevile Lubbock, the Chairman of the West India Committee wrote, January 9th, 1901: "These interesting pamphlets cannot fail to be of great value to the planting community; and it would be well if all such experiments were uniformly tabulated in a

concise a manner as are those in the Barbados and Leeward Islands' pamphlets.'

A new feature introduced in the Barbados Pamphlet Report for 1902 was a comparison between the results in that year and those of the years 1900 and 1901. The planters now clearly understand that the position occupied by a seedling cane in one year's experiments must be carefully compared with the position it occupied in the experiments of previous years. There is thus no danger of hasty generalisation from the results of any one year. Meanwhile, the planters are taken into confidence, they know exactly what is going on and are furnished with the most ·ecent facts likely to be of interest to them.

In a return recently issued by the Board of Agri-:ulture in British Guiana, it is evident that in :hat colony there are seedling canes of considerable ›romise growing on land where the Bourbon cane does ıot flourish. In other words, in some parts of British Guiana, as at Barbados and Antiqua it has been found ıecessary to substitute seedling canes for the Bourbon :ane in order to produce a high yield of sugar. :n the *Demerara Daily Chronicle* for January 10, he manager of the important Diamond Estate is]uoted as stating that about 2,000 acres of seedling :anes are under cultivation by him, and, as a rule, ' we have found them rather better all round than the Bourbon." In the Agricultural Summary for 1902, ›ublished in the *Demerara Argosy* of January 3, a orrespondent states that about 7,500 acres are under eedling canes in British Guiana, but " so far it cannot ›e said that any seedling cane has been grown which, n all round good quality is equal to the Bourbon." This appears to contradict the opinion expressed by he manager of the Diamond plantation, but the *Argosy* correspondent goes on to say " the majority ›f the seedlings, however, are hardier, and most of hem ratoon better than the Bourbon, and on poorer oils they have given returns in excess of those btained from the Bourbon grown under similar onditions."

It is evident that seedling canes, in spite of some isappointment in the past, are being carefully tested ver extensive areas in the West Indies, and we are ot without hope that seedling canes of high sacchane quality will, eventually, be obtained that will clipse the Bourbon even in its most favourable ›calities.—*Agricultural News* (*Barbados*).

TRANSVAAL FORESTRY.

Mr. D. E. Hutchins, the Cape Conservator of 'orests, who read a paper before the Society in 1899 n "National Forestry," has lately addressed the 'ransvaal Section of the South African Association t Johannesburg, on " Transvaal Forestry."

He stated that before the war there was a yearly verage of close on half a million pounds' worth of mber imported through Cape and Natal ports, and ˙140,000 worth through Delagoa Bay; the larger art of this going through to the Transvaal. Half a million pounds' worth of timber came through Cape ports during 1901. Of this the greater portion was soft wood used in house building, and most of the balance hardwood for sleepers. Return of timber imported into the Transvaal, 1897 and 1898.—1897: Manufactured, £258,741; unmanufactured, £178,145; total, £436,886. 1898: Manufactured, £217,447; unmanufactured, £130,013; total, £347,460. During the last 21 years the Cape Administration had spent over a quarter of a million on forestry. Timber was a necessity in a civilised country. Civilised man could no more do without timber than without air and water. It was not at all unlikely that the Transvaal during the next few years would require half a million pounds' worth yearly of unmanufactured timber or lumber. Was this to be brought 6,000 or 7,000 miles by sea from Australia or Europe? Obviously, the Transvaal could grow much of its own supply at a good profit. The Transvaal forestry possibilities can no more be allowed to lie idle than its mines. The Transvaal has a forest-producing power which is many times that of Europe, and every month that is lost in putting this forest-producing power into action is a dead loss to the country. What is required at once is the demarcation of the forest reserves, that is to say, the areas which will form the future national forests of the country, and the setting aside of funds, say, £100,000 yearly, to afforest those reserves. After giving further details, the lecturer concluded as follows:—" Forestry should be regarded not as a branch of agriculture to be assisted by a benevolent Government, but as a great public work of pressing necessity. We have seen how, on the most moderate computation, most kinds of timber can be grown at a profit of 400 per cent., and the present high price of timber reduced by two thirds. The good soils and fertility of the Transvaal are proverbial in South Africa. Foresters' measurements show how powerful is the vegetative process in the Transvaal, and how vast the wealth of its potential forests. The coal deposits are evidence of the rich vegetation of the past. And let us not forget the ennobling effect of forests, their fostering the love of the beautiful in Nature. Your coal is grimy, your gold is in the gloomy mines, but your forests should be the pastime and glory of your your people, the health and wealth of your children."

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock :—

MARCH 11.—" Existing Laws, By-laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions." By T. BRICE PHILLIPS. (Fothergill Prize Essay.) SIR WILLIAM H. PREECE, K.C.B., F.R.S., will preside.

MARCH 18.—" New Aspects of Life Assurance." By WILLIAM SCHOOLING.

MARCH 25.—" Oil Lighting by Incandescence." By ARTHUR KITSON.

APRIL 1.—"Application of Polyphase Motors to the Electrical Driving of Workshops and Factories." By ALFRED C. EBORALL, M.I.E.E. PROFESSOR JOHN PERRY, F.R.S., will preside.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

MARCH 12.—"The Currency Policy of India." By J. BARR ROBERTSON. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

APRIL 23.—"The Province of Sind." By HERBERT MILLS BIRDWOOD, C.S.I., M.A., LL.D. The EARL OF LYTTON will preside.

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 or 5 o'clock :—

MARCH 31, at 4.30 p.m.—"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo. The RIGHT HON. SIR GEORGE TAUBMAN GOLDIE, K.C.M.G., will preside.

MAY 5, at 4.30 p.m.—"The Lagos Hinterland: its People and its Products." By MAJOR J. H. EWART.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock.

MARCH 17. 4.30 p.m.—"Artistic Fans." By MISS HANNAH FALCKE. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

APRIL 28, 7.30 p.m.—Visit to the Whitefriars Glass Works. Paper by Mr. HARRY POWELL on "Modern Table Glass."

MAY 19, 4.30 p.m.—"Mezzotints." By CYRIL DAVENPORT, F.S.A. The process will be fully explained.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

PROF. J. A. FLEMING, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." Four Lectures.

LECTURE II.—MARCH 9.—*Transmitting Arrangements and Transmitters.*—The various elements in a Hertzian wave transmitter—The induction coil—Various forms of coil—Various forms of break—Alternating current transformers—The primary circuit interruptor—The discharger and condensers—The simple radiator—Marconi's syntonic radiator—Braun's inductive system—Multiple transformation system—Production of powerful æther waves.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 9...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. J. A. Fleming, "Hertzian Wave Telegraphy in Theory and Practice." (Lecture II.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Sir John C. Barton, "Valuation for Rating in Ireland."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

TUESDAY, MARCH 10...Royal Institution, Albemarle-street, W., 5 p.m. Sir William Abney, "Recent Advances in Photographic Science." (Lecture IV.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Sidney Preston, "Recent Irrigation in the Punjab. 2. Mr. J. B. Benson, "The Irrigation Weir Across the Bhadar River, Kathiawar."

Photographic, 66, Russell-square, W.C., 8 p.m.

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Institution, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Senator Matheson, "Australia and Naval Defence."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

Asiatic, 22, Albemarle-street, W. 3 p.m.

WEDNESDAY, MARCH 11...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. T. Brice Phillips, "Existing Laws, By-Laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions." (Fothergill Prize Essay.)

Geological, Burlington-house, W., 8 p.m.

Sanitary Institute, 74a, Margaret-street, W., 8 p.m. Dr. G. Reid, "Sewage Disposal and the qualities essential to a Sewage Effluent."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Japan Society, 20, Hanover-square, S.W., 8½ p.m. Mr. F. Y. Edwards, "Some Features of Japanese Architecture."

Sanitary Engineers, 19, Bloomsbury-square, W.C., 7 p.m. Mr. L. Aglis Dibdin, "General Municipal Engineering."

THURSDAY, MARCH 12...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. J. Barr Robertson, "The Currency Policy of India."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Society for the Encouragement of Fine Arts, 9 p.m. Conversazione at the Galleries of the Royal Institute of Painters, Piccadilly, W.

Royal Institution, Albemarle-street, W., 5 p.m. Prof L. C. Miall, "Insect Contrivances." (Lecture III.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Messrs. A. D. Constable and E. Fawssett, "Distribution Losses in Electric Supply Systems." 2. Mr. M. B. Field, "A Study of the Phenomenon of Resonance in Electric Circuits by the aid of Oscillograms."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, MARCH 13...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Mr. Karl Pearson, "Character Reading from External Signs."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. A. R. Langton, "Re-construction of Midland Railway Bridge No. 27, over the River Trent."

Astronomical, Burlington-house, 5 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

SATURDAY, MARCH 14...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "Light; its Origin and Nature." (Lecture III.)

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FRIDAY, MARCH 13, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, March 16, 8 p.m. (Cantor Lectures.) Professor J. A. Fleming, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." (Lecture III.)

Tuesday, March 17, 4.30 p m. (Applied Art Lecture.) Miss Hannah Falcke, "Artistic Fans."

Wednesday, March 18, 8 p.m. (Ordinary Meeting.) William Schooling, "New Aspects of Life Assurance."

COLLECTION OF FANS.

A collection of Fans, in illustration of the paper on "Artistic Fans," to be read by Miss Hannah Falcke, on the 17th inst., will be exhibited in the Society's rooms from March 18th to March 25th, daily, from 10 till 5 o'clock.

Members can admit their friends by the use of the usual tickets supplied to members. There will be no restriction as to the number of tickets issued.

EXAMINATIONS.

The entries for the Society's Examinations have now been received, and the steady increase in their numbers still continues. The numbers this year amount to 19,367, an increase of 3,023 on last year, when 16,344 entered. Of these 6,609 are in the Elementary Grade, and 12,758 in the Ordinary Grade. During the past ten years the numbers have more than quadrupled, for in 1893 there were 4,700 entries. It may be mentioned that of those who enter, about 9 per cent. fail to present themselves. It may, therefore, be expected that about 17,500 candidates will be examined in the various subjects. The number of centres at which the examinations will be held is 344. The Examinations commence March 30.

CANTOR LECTURES.

On Monday evening, 9th inst., Professor Fleming, F.R.S., delivered the second lecture of his course on "Hertzian Wave Telegraphy in Theory and Practice."

The Lectures will be printed in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, March 12, 1903; Sir Edward A. Sassoon, Bart, M.P., in the chair.

The paper read was "The Currency Policy of India." By J. Barr Robertson.

The paper and report of the discussion will be published in a future number of the *Journal.*

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1903 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before the 4th April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded as follows in previous years:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S.

In 1865, to his Imperial Majesty, Napoleon III.

In 1866, to Michael Faraday, D.C.L., F.R.S.

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S.

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S.

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c.

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I.

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B.

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S.

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., Member of the Institute of France.

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S.

In 1875, to Michel Chevalier.

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal.

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France.

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S.

In 1879, to Sir William Thomson (now Lord Kelvin), LL.D., D.C.L., F.R.S.

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S.

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin.

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S.

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S.

In 1884, to Captain James Buchanan Eads.

In 1885, to Mr. (afterwards Sir) Henry Doulton.

In 1886, to Samuel Cunliffe Lister (now Lord Masham).

In 1887, to HER MAJESTY QUEEN VICTORIA.

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S.

In 1889, to John Percy, LL.D., F.R.S.

In 1890, to William Henry Perkin, F.R.S.

In 1891, to Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S.

In 1892, to Thomas Alva Edison.

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S.

In 1894, to Sir Joseph (now Lord) Lister, F.R.S.

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S.

In 1896, to Prof. David Edward Hughes, F.R.S.

In 1897, to George James Symons, F.R.S.

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For. Memb. R.S.

In 1899, to Sir William Crookes, F.R.S.

In 1900, to Henry Wilde, F.R.S.

In 1901, to HIS MAJESTY THE KING.

In 1902 to Professor Alexander Graham Bell.

A full list of the services for which the medals were awarded was given in the last number of the *Journal*.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 11, 1903; Sir WILLIAM HENRY PREECE, K.C.B., F.R.S., Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Aglionby, Captain Arthur Charles, Junior Naval and Military Club, 96, Piccadilly, W.

Chichester, Hon. Mrs. Augustus, 8 Morpeth-mansions, S.W.

Griffin, Henry James, 3, Sach road, Upper Clapton, N.E.

Guyot, Yves, 95, Rue de Seine, Paris, France.

Heydeman, Harry, A.M.I.Mech.E. (P.O. Box 395), 10, Imperial-buildings, Gardiner-street, Durban, Natal, South Africa.

Longfellow, William Pitt P., 479, Broadway, Cambridge, Massachusetts, U.S.A.

Lopez, E. J., M.I.E.E., Indian Government Telegraph Department, St. John's-hill, Cleveland Town, Bangalore Cantonment, Madras, India.

Maclay, William, Thornwood, Langside, Glasgow, and Corn Exchange-buildings, Glasgow.

Rohlfs, Charles, 198-200, The Terrace, Buffalo, New York, U.S.A.

Sharp, Andrew, A.R.I.B.A., care of Messrs. Darling and Pearson, Leader-lane, Toronto, Canada.

Stark, Leopold, M.I.E.E., care of Messrs. Ganz and Co., Budapest II., Hungary.

Stewart, Charles James, 29, West-hill, Sydenham, S.E.

Sundarlal, Rao Bahadur Syam, C.I.E., Diwan of Kishengarb State, Darbar Office, Kishengarb, Rajputana, India.

Zimmir, George Frederick, Assoc.M.Inst.C.E., 82, Mark-lane, E.C.

The following candidates were balloted for and duly elected members of the Society: —

Anderson, Sir R. Rowand, LL.D., F.R.S.E., 16, Rutland-square, Edinburgh.

Baker, Charles Edmund, 54, Parliament-street, S.W. and Park Hill-lodge, Shortlands, Kent.

Calderwood, James Macdonald, M.Am.I.M.E., M.Inst.M.M., Messrs. Symons and Moses, P.O. Box 469, Johannesburg, Transvaal, South Africa.

Fraser, A. Brodie, Roddach Bow, Denton-road, Canton, Cardiff.

Grenfell, General Lord, G.C.B., G.C.M.G., The Palace, Valetta, Malta.

McLaughlin, Miss M. Louise, 2558, Eden-avenue, Mount Auburn, Cincinnati, Ohio, U.S.A.

Matland, George Read, 1, Finsbury - pavement, E.C.

Oelsner, Isidor, 31, Holland-villas-road, Kensington, W.

Quin, William James, J.P., Bishops Glen (P.O. Box 58), Bloemfontein, Orange River Colony, South Africa.

Rank, Joseph, Willersley - house, The Park, Hull.

The paper read was—

EXISTING LAWS, BY-LAWS, AND REGULATIONS RELATING TO PROTECTION FROM FIRE, WITH CRITICISMS AND SUGGESTIONS. (FOTHERGILL PRIZE ESSAY.)

By T. Brice Phillips.

The existing laws relating to protection from fire come under the heads of General, and Private or Local Acts. The chief General Statutes, in which provisions relating to this subject are embodied, are the following :—

Session and Chapter.		Title.
3 & 4 Will. 4.	c. 90.	Lighting and Watching Act, 1833.
10 Vict.	c. 17.	Waterworks Clauses Act, 1847.
10 & 11 Vict.	c. 89.	Town Police Clauses Act, 1847.
30 & 31 Vict.	c. 106.	Poor Law Amendment Act, 1867.
34 & 35 Vict.	c. 105.	Petroleum Act, 1871.
42 & 43 Vict.	c. 47.	Petroleum Act, 1879.
44 & 45 Vict.	c. 67.	Petroleum (Hawkers) Act, 1881.
38 & 39 Vict.	c. 55.	Public Health Act, 1875.
53 & 54 Vict.	c. 59.	Public Health Acts Amendment Act, 1890.
56 Vict.	c 10.	Police Act, 1893.
56 & 57 Vict.	c. 73.	Local Government Act, 1894.
58 & 59 Vict.	c. 28.	False Alarms of Fire Act, 1895.
61 & 62 Vict.	c. 38.	Parish Fire Engines Act, 1898.
1 Edw. 7.	c. 22.	Factory & Workshop Act, 1901.

The above statutes invest local authorities generally with power to provide out of public funds the necessary appliances for protection from fire, and give them control over the erection of new buildings, as well as power to secure that such buildings are erected in a substantial manner, and that incombustible materials are used as far as is practicable. The statutes further impose upon local authorities the duty of ensuring that factories and workshops are provided with sufficient and safe means of escape in case of fire; they also regulate the conveyance, storage, and sale of inflammable materials; and in some instances afford means for introducing regulations as to protection from fire into licenses granted by various public bodies.

Local Acts, *i.e.*, Acts applicable to particular towns or populous places only, are too numerous to specify in detail. These statutes, it will be found, re-enact, modify, and supplement the provisions comprised in the general laws. The objects the local enactments have in view, in some instances, include the minimising of risks attending the dangerous industries which are peculiar to certain towns or districts.

Both the general and local Acts give the authorities administering them power to make by-laws, and such by-laws, when confirmed by a Government department, have the force of legislative enactments. Power is also given to authorities to make regulations, which are binding, without departmental approval, in the localities where they are published; whilst in some circumstances, such as appertain to dangerous trades, His Majesty's Secretaries of State are empowered to make regulations.

The laws, as to protection from fire, are, in accordance with the provisions of the several statutes to which they relate, administered by various local authorities, from the county or town council to the parish council. The duties which are thereby imposed upon the authorities are usually relegated to officers specially qualified for the due superintending and carrying out of the work. Matters relating to buildings, their construction and means of exit, are entrusted to surveyors, whilst matters having reference to the extinction of fires and saving of life, the storage of inflammable materials, and the inspection and control of licensed premises, are entrusted to the police. The incidents, connected with a subject covering such a wide field, have of necessity made other persons than those referred to responsible for giving effect to some of these important duties. Doubtless from this circumstance has arisen much of the voluntary service which obtains favour in many parts of the country.

Before explaining specifically the principle underlying the statutory provisions, it may be well to give a brief outline of the laws. The statutes will be referred to in chronological order. Their history indicates a sure though gradual tendency to place upon local authorities more onerous duties in the matter of protection from fire. This has been the natural outcome of the growth of towns and populous places, for, coeval with the growth of such districts, there has arisen, from time to time, the necessity

of obtaining additional powers to the adoptive and permissive powers contained in the earlier fire-protecting measures. A tabulated statement of the Public General Statutes herein referred to will be found in Appendix A (p. 373).

General Statutes.

With regard to the Lighting and Watching Act, 1833 (3 and 4 Will. 4, c. 90), it may be mentioned that the provisions of this adoptive Act may still be adopted in rural districts. Where, however, such districts have become of an urban character, and have been invested with urban powers under the Public Health Act, 1875 (38 and 39 Vict., c. 55, s. 276), the functions of the inspectors created by the old Act devolve on the sanitary authority (*vide* 38 and 39 Vict., c. 55, s. 163). The provisions of the Act of 1833 confer, on the inspectors alluded to, powers to provide and keep up fire engines, with pipes and other utensils, to provide proper places to keep the same, and to place such engines under proper care, and to make reasonable allowances to the caretakers. (Sect. 44) A duty of the watchmen, appointed under Sect, 41, is to use their utmost endeavours to prevent any mischief by fire, and other felonies and misdemeanors, and to apprehend and secure all felons, rogues, vagabonds, and disorderly persons. The Local Government Act, 1894 (56 and 57 Vict., c. 73), made certain alterations as to the local authorities for executing the Lighting and Watching Act, 1833, substituting for the inspectors, in some circumstances, the parish council, or the parish meeting where the county council issue an order, under Sect. 19 (10) of the Act of 1894, conferring upon the parish meeting the powers of a parish council in this respect.

The Waterworks Clauses Act, 1847 (10 Vict. c. 17., ss. 38-42) contains provisions for fixing and maintaining by the undertakers, *i.e.*, by the owners of the waterworks, of fire plugs, and for charging the mains with water for extinguishing fire without charge.

The Town Police Clauses Act, 1847 (10 and 11 Vict., c. 89), as may be gathered from its title, relates to towns or populous places, and in ss. 30-33 contains power to provide and maintain fire brigades. These sections have been incorporated with the Public Health Act, 1875, s. 171, and will be referred to under that Act.

The Poor Law Amendment Act, 1867 (30 and 31 Vict., c. 106), makes it imperative on the overseers, if the vestry shall so resolve, to provide any fire engine, ladder, or fire escape, and pay out of the poor-rate the cost thereof, and of procuring a proper place wherein to keep the same, and of maintaining it, and the charges of persons necessary for the use thereof, and the cost of suitable implements and accoutrements. This enactment would seem to have been practically superseded by subsequent enactments, owing to the creation of new authorities with similar powers to those conferred by the Act of 1867. See more especially the Local Government Act, 1894 Sect. 6 (1) (c.) (ii) and Sect. 19 (10).

The Petroleum Acts, 1871-1881, are important legislative enactments with respect to the conveyance and storage of inflammable substances. The Act of 1871 (34 and 35 Vict., c. 105) declares that every harbour authority shall frame, and submit for confirmation to the Board of Trade, by-laws regulating the place at which ships carrying petroleum (as defined by these Acts) are to be moored and are to land their cargo, and setting out other precautionary measures to be observed on landing. The Acts impose specific duties on local authorities as to testing and storing of petroleum and licensing dealers.

Under Section 14 of the Act of 1871, an Order in Council may be made directing the Act to apply to other substances. Such an Order was made on 26th February, 1897, making certain parts of the Petroleum Acts, 1871 to 1881, to apply to the subtance known as carbide or calcium. Special regulations for the safe storage of that substance have been made by various local authorities, the rapid extension of the use of acetyline for lighting purposes having rendered this necessary.

The Petroleum Act, 1879 (42 and 45 Vict., c. 47) modified the term "Petroleum" to that which, when tested as provided in the Schedule to the Act, gives off an inflammable vapour at a temperature of less than 73 degrees of Fahrenheit's thermometer, instead of 100 degrees as provided in the Act of 1871.

The Petroleum (Hawker's) Act, 1881 (44 and 45 Vict., c. 67) embodies regulations for hawking petroleum, which are of a similar nature to those conditions usually annexed to licenses granted by local authorities under Sect. 9 of the Act of 1871.

The Public Health Act, 1875 (38 and 39 Vict. c. 55) contains several important references to protection from fire.

Section 66 (introduced from the Towns Improvement Clauses Act, 1847) makes it an imperative duty of every urban authority to

cause fire plugs and all necessary works, machinery, and assistance for securing an efficient supply of water in case of fire to be provided and maintained; empowers the urban authority for this purpose to enter into agreement with any water company or person; and stipulates that the authority shall, on buildings and walls near to such fire plugs, denote the situation thereof.

Section 157 of the same Act empowers every urban authority to make by-laws with respect to the structure of walls, foundations, roofs, and chimneys of new buildings, for securing stability and the prevention of fires, and for purposes of health.

Section 163 enacts that the Lighting and Watching Act, 1833, shall be superseded by this, *i.e.*, the Public Health Act, 1875, in any place which, after the passing of this Act, becomes constituted or included in an urban district.

Section 171 incorporates with the Act Sections 30-33 of the Town Police Clauses Act, 1847. These clauses impose a penalty, in urban districts, upon every person who wilfully sets or causes to be set on fire any chimney; a penalty is also incurred if any chimney accidentally catch or be on fire, unless in no wise owing to omission, neglect, or carelessness; the Commissioners may purchase or provide engines, water-buckets, pipes, appurtenances, fire-escapes and other implements for safety; may purchase, keep, or hire horses; may build, provide, or hire places for keeping engines and appurtenances; may employ persons to act as firemen; may make rules for their regulation, and give them salaries and rewards; and may send the engines and firemen beyond the limits of the special Act, for extinguishing fire in the neighbourhood of such limits at the expense of the owner of the property. These are the clauses under which fire brigades are generally maintained.

Section 233 confers borrowing powers upon local authorities, for the purpose of defraying expenses incurred under the Sanitary Acts or this Act. As these Acts comprise duties devolving upon local authorities for the prevention of fire, it may reasonably be inferred that the borrowing powers referred to should extend to loans for appliances for this particular purpose. Looking at the matter in connection with Section 285, which empowers two or more authorities to combine, for the purpose of executing and maintaining any works for the benefit of their respective districts or any part thereof, it would seem that the power of borrowing may be usefully resorted to.*

The Public Health Acts Amendment Act, 1890 (53 and 54 Vict., c. 59), under Part III., Sect. 23 (1), extends the powers of urban authorities, adopting that part of the Act, to make by-laws with respect to the structure of floors, hearths, and staircases, which are presumably intended as fire protecting by-laws. Power is also given, under the same Section (sub-section 3) to rural authorities to make certain by-laws under Section 157 of the Public Health Act, 1875, and so far as those by-laws relate to the structure of walls and floors they may be regarded as measures for protection from fire. This statute, moreover, introduces means for the regulations of places used for public resort by licenses granted by the licensing justices, who may grant such licenses subject to such restrictions as they may determine. The power here given (Part IV. Sect. 51, 1-13) has been used in some instances to make very stringent regulations with reference to protection from fire in theatres, and other places of public resort. Returns received from various large towns with reference to the precautionary measures taken in this respect are included in Appendix B. (question 3, p. 376). It may be mentioned that the London County Council's regulations, made under the Metropolitan Management and Building Acts Amendment Act, 1878, make it imperative that the parts of theatres most susceptible to fire should be adequately protected.

Part III. Sect. 36 (1-6) of 53 and 54 Vict., c. 59, enacts that every building used as a place of public resort shall, after the adoption of this part of the Act, be substantially erected and supplied with ample, safe, and convenient means of ingress and egress.

The Local Government Act, 1894 (56 and 57 Vict., c. 73), as has been noticed, made certain alterations as regards the local authorities for executing the Lighting and Watching Act, 1833, and the Poor-law Amendment Act, 1867. Other sections of this Act, as to delegation of powers, are referred to in Appendix A (p. 373).

The Parish Fire Engines Act, 1898 (61 and 62 Vict., c. 38), administered by parish councils,

* In connection with this matter it may be noted that the amount of loans received by local authorities for fire engines and other appliances (including fire stations) has varied from £29,311 in 1884-85 to £161,517 in 1899-90, and the outstanding loans of the local authorities under the same head show a progessive increase from £308,508 in 1884-85 to £1,014,679 in 1899-90. (31st Annual Report of the Local Government Board, 1901-1902, pp. 622 and 630.)

enables such councils to agree with any neighbouring borough or district council that fire engines may be used in the parish, and the owner is exempted from the charge imposed in Sect. 33 of the Town Police Clauses Act, 1847.

The Factory and Workshop Act, 1901 (1 Edw. VII., c. 22) is the most recent Act containing provisions with regard to protection from fire, and in this matter consolidates all previous factory Acts. The main provisions under this head are contained in Sections 14, 15 and 16. Sect. 14 is divided into eight lengthy sub-sections.

By sub-section (1), every factory and workshop, the erection of which was not commenced on or before the 1st of January, 1892, as to factories, and on or before the 1st of January, 1896, as to workshops, and in which more than forty persons are employed, must be furnished with a certificate from the district council that the factory or workshop is provided with such means of escape . . . . as can reasonably be required under the circumstances of each case: it is a duty of the district council to examine every such factory and workshop, and on being satisfied . . . . to give such certificate, which must specify in detail the means of escape so provided.

Sub-section (2) provides that with respect to all factories and workshops wherein more than forty persons are employed, and to which the foregoing provisions do not apply, it shall be the duty of the district council to ascertain from time to time whether they are provided with such means of escape as aforesaid, and where not so provided, to serve notice upon the owner specifying the measures necessary for providing such means of escape, and the owner shall take steps for complying with an order of the council, notwithstanding any agreement with the occupier, and shall be liable to a fine not exceeding one pound for every day that the non-compliance continues.

Sub-sections (3) to (8) provide for arbitration; for settlement as between owner and occupier; define the powers of inspectors; stipulate that means of escape shall be maintained in good condition and free from obstruction; that the whole of a tenement, factory, or workshop, shall be deemed one factory or workshop; and provide as to defraying expenses incurred by district councils in urban and rural districts.

Section 15 enacts that every district council shall, in addition to any powers they possess with reference to prevention of fire, have power to make by-laws providing for means of escape from fire, in the case of any factory or workshop.

Section 16 provides that while any person is employed in a factory or workshop, the doors must not be locked or bolted or fastened that they cannot be easily opened from the inside: and in every factory or workshop the construction of which was not commenced before the 1st January, 1896, the doors of each room, in which more than ten persons are employed, shall, except in the case of sliding doors, be constructed so as to open outwards. Severe penalties are imposed by the Act in cases of non-observance of the requirements of the Act and By-laws. (Ss. 135 and 136.)

In addition to the general statutes outlined, there are others which bear more or less upon the subject, and which may be incidentally referred to in the course of this paper, such as the Explosives Act, 1875, the Police Act, 1893, the Uniforms Act, 1894, and the False Alarms of Fire Act, 1895.

The brief review of the general statutes shows that from 1833 to 1901 the more populous places have been invested with further powers from time to time. But in some cities and large boroughs even those powers have been found inadequate, and legislation of a local character has been the result.

Local Statutes.

Amongst the numerous Local Acts those of Liverpool present some unusual features. An Act of the 6th and 7th Victoria, chap. 109 (1843) for the better protection of property in the borough of Liverpool from fire, so far as it remains unrepealed, and an Act of the 7th and 8th Victoria (1844) to alter and amend the above-mentioned Act, still form some of the measures for protection from fire in that city. Those Acts embody very stringent regulations as to the construction of new, and the alteration of old, warehouses, and include general precautions for the storage of mineral acids, and chemicals of inflammable nature. They also regulate certain dangerous trades; provide for the licensing and registration of warehousemen and porters, and include power to make by-laws.

The Liverpool Improvement Act, 1842, Sect. 162, enacts that all extraordinary expenses of the fire brigade, incurred at fires, are to be paid by the respective insurance companies who have issued policies covering the property attacked, and by the respective proprietors of uninsured property attacked.

The Liverpool Acts thus contained drastic precautions against fire some thirty years prior to the Public Health Act, 1875, and in the

unique arrangement as to making a legal charge upon insurance companies and owners, for services rendered in the extinction of fires, Liverpool has for many years set an example which is likely to be more generally followed in the future.

Of the enactments which refer to hazardous industries, and their attendant risks from fire, the legislation for coal mines may be cited as an example. The Coal Mines Regulation Act, 1887 (50 and 51 Vict., c. 58), contains provisions against fire in mines, and gives power to the Secretary of State to make special rules, subject to arbitration in cases of dispute. The special rules as to fire protection refer generally to the inspection of working places by mines' officials, technically termed in some districts "firemen"; to precautions as to the use of explosives in mines; and to the regulation of workmen with the view of preventing naked lights or combustible materials being carried into the mines. The Coal Mines Regulation Act is administered by His Majesty's inspectors of mines, who act under the direction of the Home Office.

There are other Acts which give power to the central authority to make, or to sanction, special rules or regulations as to dangerous trades, such as the Alkali, &c., Works Regulation Acts, 1881 and 1892, and the Factory and Workshop Act, 1901. It is, however, doubtful whether the Legislature intended such rules to embody protection from fire, inasmuch as it has been ascertained that no special rules or regulations have been made under those Acts, having reference to this subject.

By-Laws and Regulations.

With reference to the by-laws adopted by local authorities, they have in the main been framed on the model by-laws issued by the Local Government Board. These prescribe in detail the thickness of walls of varying height and length, the kind of materials to be used in their construction, the thickness of chimney breasts and jambs, and of brick-work or stone-work surrounding flues. Further precautions are set forth in detail as to the construction of roofs, party walls, flues, and smoke pipes. The by-laws made under Sect. 23 of the Public Health Acts Amendment Act, 1890, embody somewhat similar rules with regard to floors, hearths, and staircases. Penalties are enforcéable for non-compliance with by-laws.

Although the powers to make by-laws conferred by the Public Health Acts apply to urban districts, the rapid development of building operations in some rural districts has led the councils in those areas to apply for, and the Local Government Board to invest them with, urban powers for this purpose, under Sect. 276 of the Public Health Act, 1875. It should also be mentioned that new model by-laws for rural districts have recently been issued by the Local Government Board, in which the precautions as to protection from fire have been withdrawn, in common with other alterations of the building by-laws. The object appears to be to reduce the cost of building, which in rural districts has become so great as to sometimes prevent the erection of houses suitable for the working classes. The effect of this alteration can only be known after those by-laws have been in force some time.

It has been seen that the Factory and Workshop Act, 1901, confers powers to make by-laws (Sect. 15), but it is not possible to indicate their exact tenor yet, the Act having only been in operation this current year. It may be useful, nevertheless, to note the steps taken by the London County Council under previous factory Acts, as by-laws would be likely to follow upon those lines. The Council on the 13th June, 1899, approved a statement with reference to the requirements in respect of the means of escape in case of fire to be provided in accordance with the provisions of Sect. 7 of the Factory and Workshop Act, 1891, and Sect. 10, Sub-section (4), and Sect. 22 (1), (iv) of the Factory and Workshop Act, 1895. This statement is now undergoing revision, but the new regulations are not likely to be ready to be noted in this paper.* The County Council has approved of alterations in factories under the statement referred to. The restrictions for new factories ensure that there are sufficient exits, and that such exits are kept free from obstructions; that staircases are constructed of incombustible materials, with enclosing walls carried up above top floor storey, and with exit on to roofs; that widths of treads and heights of risers in staircases are of such sizes as to afford the most easy means of ascent or descent, whilst steps must be solid square or spandril, arranged in straight flights without winders, so as to avoid the blocking of passages at any angle, in the case of a hurried retreat by a number of persons. The arrangement of staircases in flights also lessens the risk of entire destruction of these means of escape. In enclosing staircases and lifts, such parts of a building might be

* The revised statement, dated 22nd July, 1902, contains somewhat similar regulations.

left standing, even though the building itself becomes gutted. The regulations also provide for doors and windows to open freely. In the case of old buildings, the enclosed staircases are not specified to be of brick or stone, but of fire-resisting materials, with handrails on each side, and soffits rendered with fibrous plaster. In a factory having frontages to two streets, and consisting of two buildings, the upper floors of which were disconnected, it was arranged, after arbitration, to provide iron bridges between the two buildings on the upper floors, thus making exits to both streets from either building.

As to regulations, those made by local authorities under the Pretroleum Acts include restrictions as to the buildings in which petroleum is stored, and precautions as to the handling of the oil, whilst those with reference to carbide of calcium embody additional precautions to ensure that this substance is kept dry.

The statutes under review, both general and local, fall under two classes (*a*) those of a purely preventive nature, which take effect whether fires occur or not; and (*b*) those relating to the actual extinction of fire.

Laws Relating to Prevention of Fire.

The preventive laws have reference to the structure of buildings, and to the storage and conveyance of dangerous substances. In the same category must be included the laws in reference to the provision of water for the purposes of fire extinction.

The by-laws comprise, perhaps, the most important part of the preventive laws. With regard to by-laws made under Sect. 157 of the Public Health Act, 1875, it is difficult in some instances to define how far they actually refer to fire protection, and how far to other matters. The Act sets out that they are made "for securing stability and the prevention of fires, and for purposes of health." "Stability" and "prevention of fire" are included in the same sentence, but the means adopted for securing stability do not necessarily conduce to the prevention of fire. It has been noticed that the main provisions of the by-laws control the thickness of walls. So far as stability is concerned it is a fundamental principle of building construction that the lower walls of a building of several storeys should be stronger than those of the higher storeys, inasmuch as the former have to carry greater weight. This principle has been faithfully adhered to throughout the by-laws. But it should be observed that so far as the prevention of fire alone is concerned, the danger increases as the higher parts of a building are reached. From this it would follow that if thickness of walls were the only protection against fire, the walls in the higher storeys should be more stable, and, therefore, thicker than those in the lower parts. This is of course impracticable, but the argument shows that "securing stability" and "prevention of fire" are not identical under all conditions. It would have been better if the distinction between the two things had been more clearly defined in the Public Health Act. The fact also that the Act empowers urban authorities to make by-laws with respect to the structure of walls, foundations, roofs, and chimneys only, precludes any further preventive measures being enforced in upper storeys. Had the fact of the increasing danger from fire, in the higher parts of buildings, been kept distinct from the question of stability, it is probable that the necessity of making by-laws, for the inner constructive details of upper storeys of buildings, would have become more apparent, and that some minor risks, now entirely unprovided against, would have been minimised.

Want of clearness in definition is noticeable also in the Public Health Acts Amendment Act, 1890, Sect. 23 (3), which extends the provisions of Sect. 157 of the Public Health Act, 1875. This sub-section sets out that the by-laws are "for purposes of health," and the preceding part of the sentence used in the Public Health Act, 1875, "for securing stability and the prevention of fires" has been omitted. Yet, if the Acts of 1875 and 1890 are read together, it is difficult to draw any other inference from them than that the by-laws are intended for the same purposes under both Acts.

By-laws, again, do not in some respects fal[l] into line with the requirements of the presen[t] time. Since 1875, the date of the Act unde[r] which the principal ones were drawn up, man[y] advances have been made in building con[-] struction, and particularly with regard to th[e] prevention of fire. Valuable experimenta[l] work has been carried out in various sphere[s] as to the effect of fire upon different material[s] and under varying conditions. In this respec[t] the efforts of the British Fire Prevention Com[-] mittee deserve to be mentioned, for under th[e] auspices of that committee valuable work ha[s] been performed. Furthermore, it is a subje[ct] of keen discussion in architectural and buildin[g] circles which of two distinct types of buildin[g] construction possesses the greater advantage[s]

that of slow-combustion, or that of non-combustion (or fire resisting). The by-laws refer simply to the use of "incombustible materials." Such a term needs definition, as is shown by the fact that a schedule has been added to the London Building Act, 1894, specifying the materials which shall be deemed to be "fire-resisting" within the meaning of that Act.

From the foregoing remarks it would appear desirable that the by-laws made under the Public Health Acts, in so far as they relate to protection from fire, should be remodelled upon more modern lines. The matter could be taken into consideration by such a committee as will be suggested in this paper to inquire into the preventive laws. Much useful information may be gathered from some of the foreign by-laws. For instance, the "Regulations of the Chief of Police for the City of Paris, concerning preventive measures and rescues from fire," dated 1897, and the "New Building Ordinance and Health Ordinances of the City of Chicago," dated May 1st, 1895, both contain some regulations which might be advantageously adopted in England.

Other by-laws of more recent date have also been severely criticised in technical circles. Such are those made by the London County Council under the Metropolis Management and Building Acts Amendment Act, 1878, for the protection of theatres from fire, and the regulations as to means of escape from fire for factories and workshops. It is sometimes argued that by-laws and regulations are so detailed as to defeat their own ends by rendering proper inspection impracticable; that they are of too bureaucratic a type to be of practical use; and that they press too harshly upon property owners. Such criticisms are generally made in architectural quarters, and some allowance must be made for the fact that all restrictions contained in by-laws must of necessity hamper to some extent the freedom of that profession. The views, however, of such an important profession deserve consideration. The two criticisms that the by-laws defeat inspection by reason of their minuteness, and that they are too bureaucratic, do not carry much weight in themselves. With regard to the third criticism, it will be shown hereinafter, that, as a rule, the Legislature has sufficiently guarded the rights of property owners.

But if by-laws are in advance of their administration, as is implied in the first criticism, that is a fact which emphasises the necessity of improving the methods of inspection. And on this score the Public Health Acts, at any rate, are open to critisism, inasmuch as they do not compel local authorities to appoint properly qualified persons to carry out duties, which often include the protection of life and limb, and which can only be efficiently performed by men or women of special training and experience.

The need of compulsory legislation with regard to fire protection will be referred to in this essay, and included in any such legislation should be the power to appoint inspectors. For the inspection of buildings after fire is an important necessity, and at present is not in any way provided for by legislation. It is most regrettable that no official records have been kept of the effects of fire upon buildings. Work of this nature should be entrusted to fire inspectors, whose duty, in addition to administering the preventive laws, would be to inspect and make after-fire reports to their several departments. Had this been done during the last 20 or 30 years, much valuable official information of a reliable kind would now be available, which would indicate how far existing laws have protected property from fire. The work here outlined is not such as the chiefs of fire brigades can be expected to perform. The reports of those officials now contain some particulars of damage done to buildings (*vide* the report of the Fire Brigade Committee of the London County Council, 1901, pp. 28-34), but they are not of the detailed character which properly qualified fire inspectors would have prepared. Some work of the kind is carried out at Glasgow, as the following extract from the report of the Glasgow Fire Brigade for 1901 shows:—

"Defective building construction still bulks largely in our list of causes of fires. This is an inheritance that will last for a long time. Improvement may be looked for in the stringency of the Building Regulations Act, and in the inspection and proper repair of all buildings damaged by fire from this cause. All fires arising from defective building construction are at once reported to the Master of Works, whose staff visit and instruct how restoration is to be safely carried out."

Fire inspectors should be given some similar powers to those of surveyors or sanitary inspectors, and premises where fire had occurred should be brought under the operations either of special building by-laws, or it might be convenient by extending the meaning of the term "nuisances" to bring such premises under Sect. 91 of the Public Health Act, 1875, so as to ensure that in reconstruction proper pre-

cautions are taken against a recurrence of fire. The larger boroughs should appoint their own fire inspectors, but other councils should be invested with power to unite for the purpose of such appointments. A similar power of combination by district councils is already contained in Sect. 286 of the Public Health Act, 1875, as to the appointment of medical officers of health, and in any legislation upon the present subject, the section might, with slight modification, be made applicable to the appointments now suggested.

Another criticism raised as to by-laws is that they apply to new buildings only. The Coroner's jury, in their verdict on a recent fire in Queen Victoria-street, London, recommended that the London Building Act of 1894 should be made retrospective in the matter of provision of escape from fire. Involved in such a recommendation is a principle with which, in the past, the Legislature has not too readily interfered. In most Acts of Parliament a distinct line has been drawn between existing, or old, and new properties. Throughout the Public Health Acts this distinction is specially observable, and those Acts seem to be permeated with the doctrine that old buildings are not to be tampered with unless actual necessity arises for so doing. For instance, the local authorities have no power to insist upon alterations in sanitary arrangements, however obsolete they may be, so long as they are not defective, or do not, through such defects, create nuisances. When nuisances arise, the authorities have powers to specify the works necessary to be carried out. So jealously has the Legislature guarded the rights of property owners in this matter, that it has been by gradual steps only that any alterations in the law have been made. Indeed, it is sometimes necessary to prove actual injury to health before any action can be taken under the Public Health Acts. This latter condition has been found to unduly hamper the operations of sanitary authorities, and, as a consequence, the corresponding section in the London Public Health Act of 1891 was altered to include any premises "injurious *or dangerous* to health," thus giving the right of action in the face of danger, apart from the question whether injury has arisen or not. A further proof of the distinction drawn between new and old property is found in the Factory and Workshop Act, 1901. Section 14, already mentioned, has reference to fire escapes, both for new and old factories, but it is noticeable that the requirements for both, though apparently the same, are defined separately, indicating that what might be considered a "reasonable requirement" in the case of new factories or workshops might not be so in the case of existing buildings. Hence, a precedent, to take the drastic step of making by-laws as to fire prevention retrospective, remains to be established, and doubtless there will arise practical difficulties in the way of applying one and the same by-laws without distinction to all buildings.

A somewhat similar proposal, to make the Factory and Workshop Act, as to the provision of means of escape from fire, apply to all factories, irrespective of whether more than forty persons are employed therein, has been made in some quarters. The Legislature, in the Act of 1901, retained that number, which had first been mentioned in the Act of 1891, Sect. vii. (1) and (2), and introduced a new provision in the Act of 1895, Sect. 10 (3) as to doors, to facilitate escape in rooms where more than ten persons are employed. That provision has been made more stringent by Sect. 16 of the Act of 1901. Gradual steps have thus been taken in reducing the specified number of employed persons in factories to which the Acts apply. Altogether it seems a a proper course to gradually bring about such alterations, rather than to precipitate great changes. The question, whether and to what extent the laws and by-laws in this respect may be amended, might, with advantage, be referred to the committee hereinafter alluded to.

In view of the criticisms which have been made with regard to existing by-laws, it should be stated that those by-laws have certainly not been without useful effect, although, as has been pointed out, there are only meagre official records as to their precise results. A report of the London County Council states that "In 1886, 25 per cent. of the fires in London were classed as serious, that is fires involving considerable loss." The number is now reduced to between three and four per cent., although fires are now returned as serious which would not have been accounted so 30 years ago. Two factors have doubtless contributed to this, (*a*) the effective carrying out of the buildings Acts by the council, and (*b*) the increased efficiency of the fire brigade.

The enactment (38 and 39 Vict. c. 55, s. 66), for the provision, in urban districts, of fire plugs and efficient water service for the use of fire brigades, is one of the preventive fire laws,

and though compulsory, does not appear to have been effectively carried out. The Select Committee of the House of Commons on Fire Brigades, in their report of 25th July, 1899 (Appendix No. 24), show that out of 1,025 urban districts, 116 were without sufficient hydrants, and in 119 the water supplies were defective. The Local Government Board have power, under Sect. 299 of the Public Health Act, 1875, to compel local authorities, when in default, to carry out their duties. It does not appear that these powers have been exercised in relation to protection from fire, but this is not surprising, when it is borne in mind, that the particular enactment referred to was, prior to the passing of the Factory and Workshop Act, 1901, almost the only compulsory one bearing upon this subject. Doubtless, if permissive enactments were substituted by compulsory statutes, the central authority would have stronger grounds for enforcing the performance of duty by defaulting authorities. It may be mentioned, in this connection, that the appointment of permanent Government inspectors of fire brigades would be undesirable, because on grounds of public policy it has been considered inexpedient to unduly interfere with government by local bodies in matters affecting the several localities. Still, it cannot be too clearly emphasised that it is absolutely necessary to set aside the permissive nature of the existing laws in order to bring about efficiency.

With reference to the preventive measures taken as to the storage and conveyance of inflammable substances, the report of the chief officer of the Public Control Department of the London County Council for 1901-1902, contains a useful suggestion as to the desirability of amending the law with regard to the quantity of explosives which may be kept in premises registered by the local authority under the Explosives Act, 1875. In the same report it is pointed out, with regard to the Petroleum Acts, that although a Select Committee reported in 1898 that the flash point of petroleum should be raised from 73° to 100° Fahr., nothing has yet been done. Such an alteration would bring most of the paraffin oil usually burnt in ordinary lamps, and now stored without license or restriction of any kind, under the provisions of the Petroleum Acts. Some of the cheaper oils have a comparatively high flash point. The report referred to gives details of 19 lamp accidents, involving the loss of 21 lives, in the county of London, during the year ended 31st March, 1902. The flash point in several instances was found to vary from 82° to 103° Fahr. Lamp accidents are a constant source of danger. In London, between 20th July, 1890, and the 31st March, 1902, the inspectors investigated 2,463 separate accidents, 293 of which terminated fatally, and resulted in 323 deaths. The following statement, compiled from reports of the chief officers of fire brigades of various towns, emphasises this :—

Year.	Town.	Total number of fires.	Total number of lamp accidents.	
1901	London ..	3,684	246	Average percentage of lamp accidents 7 per cent.
1901	Glasgow ..	759	10	
1901	Liverpool .	749	68	
1901-2	Edinburgh	410	16	
1901	Dublin ..	127	4	
1901	Paris	1,422	160	

In relation to this matter, some valuable suggestions have been issued by the Secretary of State for the Home Department, as to the care and use of petroleum lamps. The Board of Education have adopted those suggestions, with the view of their being taught in schools, a step which should reduce the risk of accidents from want of proper knowledge as to the use of such lamps. The suggestions are set out in detail in the report for 1901 of his Majesty's Inspectors of Explosives.

From the foregoing remarks, it will be gathered that the amending of the statutes as to inflammable substances might also form a subject of enquiry.

The preventive fire enactments having reference to places of public resort, and which are generally embodied in regulations annexed to licenses, may be criticised on the ground of the unlimited power of those granting such licenses. The Licensing Justices may impose such restrictions as they may determine (53 and 54 Vict., c. 59, s. 51-2). This is another instance of permissive power, and the discretion allowed has resulted sometimes in regulations beng made, the only objections to which can be taken on account of their extreme stringency, whilst in other cases little, if any, use has been made of such powers. Examples of the varied practices in vogue may be found in the stringent regulations made by the London County Council as to theatres, and in the regulations prevailing in various other towns, as indicated by the answers received to question 3, included in Appendix

B (p. 376). It is very desirable that the law should beso altered that such regulations may be made under more definite powers, given by some principal Act dealing specifically with protection from fire.

A Select Committee of the House of Commons reported on the 16th July, 1900, as to existing arrangements for the provision of fire brigades. The committee stated that though a considerable amount of evidence of the utmost importance was adduced, with reference to structural arrangements of buildings, it was not within the scope of their inquiry, and no recommendations were therefore made on the point. It might now be suggested that it would be desirable to appoint a similar committee, to enquire and report on the existing arrangements for the prevention of fire (as distinct from fire extinction), the adequacy of such arrangements for the due prevention of fire, and the amendments, if any, which are necessary or desirable in the statutes relative to the subject.

Laws Relating to Extinction of Fire.

The statutes in relation to the extinction of fire are even more open to criticism than those appertaining to the prevention of fire. In a word, they are indefinite, piece-meal, and permissive. They are indefinite as to the powers they confer; piece-meal, being scattered provisions in various Acts of Parliament, promoted mainly for other purposes; and permissive, as evidenced by the anomalous state of affairs arising out of inefficient administration.

The provision of fire brigades is an example of what has been stated. From evidence given before the Select Committee, it would appear that chaos reigns in the management and support of fire brigades. In some towns there are police brigades, in others, professional brigades, and in yet others volunteer brigades, whilst retained brigades, and private brigades also exist, and some "bogus" brigades seem to find lucrative "employment" in soliciting subscriptions for fire brigade "work" which is never performed. The manner of supporting brigades shows the same variety. Amongst volunteer brigades, some are "purely volunteer," who provide and maintain their own brigades for the public use; some are "partly paid," receiving some support from local authorities by way of an annual subscription, or the gift or loan of engines or appliances. The retained brigades receive "retaining" fees.

It may be doubted whether expenditure by local authorities by way of subscription to partly paid volunteer brigades is a proper application of a public rate. Section 32 of the Town Police Clauses Act, apparently supports this view. "The Commissioners . . . . . may employ a proper number of persons to act as firemen." The word "employ" presupposes the exercise of some control by the employers. Appendix B (question 5) shows the manner in which various brigades are supported, and the return from the Corporation of Lewes is deserving of note. In that borough a grant of £50 a year is made toward the support of a volunteer brigade. In addition, the Corporation provides and maintains all plant and appliances. Thus, for the year ended 31st March, 1902, the Corporation subscribed £50 out of a total expenditure of £57 10s. 1d. This case is typical of the practice followed in other towns, in which payments are made out of the public rates without that full supervision being exercised which is implied in the term "employ." In such instances the relations usually existing between the employer and the employed should be strictly observed between the public body and the members of fire brigades. This is impossible so long as fire brigade service is expected to be "voluntary." Moreover, under the existing laws, little, if any, blame can be attached to local authorities for laxity in this matter, for it is the permissive and indefinite character of the law upon the subject, which gives rise to such anomalies. The law in some cases has induced authorities to go beyond their legal powers, and in others has allowed them to become apathetic as to the exercise of powers entrusted to them in the matter of fire extinction. In England alone, out of 1,025 urban districts, there were in 1900 no less than 266 districts, with a population of five millions, and a rateable value of 1¼ millions sterling, without fire brigades. It has, moreover, been given in evidence before the Select Committee that the general provision for protection from fire, in rural and other scattered districts, is also deficient.*

The permissive nature of the enactments as to the extinction of fire has also brought about

* A return made to the House of Commons, dated 27th July, 1899, shows that the numbers of local authorities supporting, or contributing to the support of fire brigades, was as follows:—270 Town Councils, 465 Urban District Councils, 17 Rural District Councils, 283 Parish Councils, and 4 parishes, lighting inspectors. There were many cases in which money had been expended by local authorities for fire extinguishing appliances, but there were no organised brigades. These latter authorities were not included in this return.

an anomalous state of affairs as to the relative positions of governing bodies and individuals. The varying customs of local authorities have given some grounds for argument as to what the duties of the State should be in this matter. For the purpose of the remarks that follow, the word "State," being a convenient term, is used to denote a supposed amalgamation of the whole of the governing bodies of the country, and not in its strict aud literal meaning. Fire prevention involves the protection both of life and property, and in the actual work of extinguishing fire it is impossible to separate the two. The duties as to the saving of life admit of very little argument. The State has for many years, by legislation, exercised almost a paternal control over the health of the individual, and has likewise sought to protect his life and limb from dangers in various spheres of industry. It may therefore be accepted, for the purposes of this paper, that it has become a recognised public duty to protect the lives of individuals from such a dire peril as fire. But whether it is also the duty of the State to protect private property is a question upon which considerable difference of opinion may exist.

The subject has been made more complex by the position occupied by a third party between the State and the individual. Fire insurance has become so general that the relations, of fire insurance corporations, to the State and to the individual, must be considered in any discussion relative to fire protection. Fire insurance implies that the individual contracts with a wealthy corporation, who, in return for a comparatively trifling annual contribution, undertake to reimburse to him his loss of property in the event of fire. The State, through its local authorities, exercises control over such property, expends certain moneys in protecting it from fire, and saves it when actually exposed to fire. Thus the State, in effect, becomes an agent of the insurance companies. Yet, except for small amounts paid by the insurance companies under exceptional arrangements, the State receives no consideration for the services so rendered.

Should governing bodies then be recompensed for such services, and if so, by whom, and to what extent? It has been held in some circles that it is a public duty to protect property from fire, and that governing bodies should therefore meet all such expenses out of the public purse. It has also been urged that this is as much the duty of the State as it is to protect the public from robbery by the employment of police, or as it is, by the work of public health departments, to protect the general health of the public. It would be as reasonable, it has been contended, for municipalities to ask burglary and life insurance companies to contribute to the expenses of the police force and sanitary departments respectively, as to ask fire insurance companies to subscribe toward the maintenance of fire brigades. The apparent inference to be drawn from this last statement, is, that the police help burglary insurance companies by preventing robbery, and that the work of public health departments aids life insurance companies by protecting health, and thus prolonging life. The contention contains an implied admission that public bodies do render services to the two branches of insurance mentioned, and thus the argument loses force. For, if it be granted that burglary and life insurance companies are benefited by the work of local authorities, it is obvious that the services, rendered by fire brigades to fire insurance companies, are more direct, and more capable of being accurately assessed.

Further, it may be shown, that to undertake extinction of fires as a public duty, and in protection of private property, the State would be going far beyond any principle involved in the work carried out, either in police establishments, or in public health departments. For, in those branches of local government, the State confines itself to administrative duties of a preventive kind, both as to crime and as to disease. The State seeks to prevent robbery, but it does so in an administrative capacity, and acts primarily with the view of the prevention and the punishment of crime. It does not do so on the assumption that it is a public duty to prevent the loss of private property to the individual. In public health matters the State seeks to prevent the spread of disease, but it does not thereby relieve individuals of their responsibilities as owners of private property, nor yet, when in ill-health, of the expenses of their medical attendants. In fact, the State adds to the private responsibilities of individuals in such matters, for where public health is endangered through insanitary conditions, the duties of the State, acting through the local authorities, are in the main confined to enforcing owners or occupiers, as the case may be, to carry out works, at their own expense, for the protection of the public health. There is, moreover, a distinct difference between protection from robbery, from insanitation, and from fire. Robbery is a crime, and

the duties of the State, in all civilised countries, with regard to crime, have been so well defined as to need no comment. Insanitation is in most cases the result of some act of omission or commission of the individual, and he is accountable to the State so far as his offence is one against public health. Protection from robbery and from insanitation are to this extent similar. In both instances the offenders are punished for their own acts; the one for his crime against the community, the other for his offence against the public health. But the ravages of fire, except in incendiarism, which is treated as a crime, are not generally the result of an act which entails any punishment upon the individual. Fire has long been looked upon as an "Act of God," as is evidenced by the clauses of exemption inserted in many leases. An entry in the "Annals of Liverpool," dated 1650, shows that this has been the view held for many years. It reads: "Ordered 'that the bailiffs cause leather buckets and four or six hooks to be made for pulling down any house being on fire, which God defend.'" Although in the literal sense the last part of the quotation may not be universally accepted, it bears out the view that fire has been considered as an "Act of God," and is true in so far as it implies, that, despite all preventive measures, that may be taken by man, fires will still occur. And having taken preventive measures by way, for instance, of building regulations, and having done all that can be done to protect and save the life of the individual, the State has fulfilled its duties, and so far as the extinction of fire is confined to efforts to save property, the expenses and responsibilities so incurred should fall upon the owners of the property concerned.

Before proceeding to deal with the incidence of this cost, it should be pointed out, that, apart altogether from the fact that it would be wrong in principle for the State to accept the duty of protecting property from fire, such a system would be likely to have results too far-reaching to be contemplated with any degree of composure. It has been stated that enactments referring to certain hazardous industries, so far as they refer to risks from fire, come within the scope of this paper, and the legislation for coal mines has been cited as an example. If public moneys are to be spent in protecting property, it is clear that all classes of property should benefit, and it would follow that the property of a mine owner or that of the proprietor in any other trade involving great risks from fire, should be so protected. This would mean a far greater call upon the rates than is at present contemplated by those who favour State control. Yet there is no valid reason why such property should be exempted. The coal owner, for example, may make out a very good case for State aid. A great part of his property is uninsurable, the dangers contingent to his trade operations have brought about drastic legislative measures which have added considerably to his expenses; he is, too, in most cases, a large ratepayer. The legislation referred to has, *inter alia*, compelled him to provide, at his own expense, an expert staff of officials, whose duties are, to a great extent, of a fire-protecting nature. Yet he receives no relief from the rates, though it is manifest he is doing the work which, some would urge, should be paid for out of public funds. Great havoc is sometimes wrought to life and property by fire in mines, and before unreservedly accepting the statement, that it is a public duty to protect all property from the ravages of fire, it will be well to bear in mind the far reaching results which the adoption of such a principle might involve.

It has been stated that the expenses of fire-extinction, so far as they relate to the protection of property, should fall upon the owner of the property concerned. The term "owner" in this connection should be taken to mean the person or persons interested, for the time being, in the property. This is consistent with the definition of the word in the Public Health Act, 1875. Seeing that from the time of the outbreak of fire, in the case of insured property, the insurer, that is the insurance company, is interested to the extent of the loss caused by the fire, it seems fair that the insurance company should recompense the State for the services rendered by fire brigades. In the case of uninsured property it should be possible to arrange a scale of charges for the use of fire brigades.

The Select Committee on Fire Brigades, in their report, dated 16th July, 1900, observe "that fire insurance companies should be required to contribute some portion of the expenses connected with fire extinction," and with regard to these questions the committee came to the following conclusions:—

"179. The committee, after a careful review of the whole case as it has been placed before them, have come to the conclusion that all fire insurance companies should be required by law to bear a certain portion of the expenses connected with fire extinction, which is an obligation already recognised by some of the most important companies.

"180. They do not think that there would be any difficulty in settling the form in which the contribution should be levied. Perhaps the most convenient way would be to legalise the method which fire insurance companies to such a large extent voluntarily adopt at the present time.

"181. By this method insurance companies, in case of fire in premises insured by them, would be required by law to pay for the use of appliances, and for services rendered at each individual fire according to the local scale of charges, which apparently it is the custom of most fire authorities to frame."

By the arrangement proposed above, the local authorities would receive payments only in the case of fires taking place, whilst they would maintain brigades at all times, whether fires occurred or not. Under such an arrangement, a town, in which preventive measures were so perfect as to reduce fires to their irreducible minimum, or, were it possible, to cause their absolute disappearance, would by reason of its excellent fire service, be without any support from the insurance companies. In fact, as increased expenditure, under proper administration, should result in increased efficiency, with a consequent reduction in the number of fires, the insurance companies' contributions would decrease in the inverse proportion to the increase in public expenditure, and would possibly reach vanishing point in the best equipped towns. In other words, in places where they received the most aid from the local authorities, their payments would be the least.

A proposal, which, at the instance of the Sunderland Corporation, has received the approval of 79 out of 162 municipalities, is to petition the Government in favour of the promotion of a Bill providing for the payment of one-half of the cost of the maintenance of a fire brigade and establishment in each city or borough by insurance companies. The proportion of one-half appears to be an equitable one to take, seeing that brigade work is for the protection of life and property, and that the former is an acknowledged duty of the State. It has been suggested that the charge should be made upon the companies effecting insurances in the respective towns. It would, however, appear to be a more desirable plan to levy a tax upon insurance companies generally, and to make the proposed laws include all areas. A fund so created could be administered by the public department concerned, and be distributed to the various authorities throughout the country, on a basis to be agreed upon. The fixing of this basis is difficult, but the difficulty would not seem to be insurmountable. Each authority, in consideration of the expenditure incurred on account of protection from fire, would be entitled to an annual contribution. But it should be an essential part of any such scheme that the present permissive enactments should be superseded by compulsory statutes. Local authorities, as representing the general public, would benefit by the increased efficiency which would result from such an arrangement, and insurance companies would also derive such advantages from the improved service as would eventually, in all probability, exceed in value the amount of their contributions under the proposed scheme.

To what extent should insurance companies be taxed? There are, unfortunately, no available returns as to the exact extent of fire insurance in the country, and even at the select committee no evidence was given upon this point, although some attempts were made to elicit this information. Under the Metropolitan Fire Brigade Act, 1865, section 13, the insurance companies in London have to contribute to the extent of £35 per million pounds sterling of the gross amounts insured in respect of property in the Metropolis. This produced £32,386 in 1901, showing that, in round figures, 1,000 million pounds sterling are carried in London.

The following figures give (nearly) the gross rental value of property in the United Kingdom:—

	Gross Rental.	Rateable Value.
England and Wales ..	£216,640,573	
Scotland	27,107,045	
Ireland (estimated from rateable value)	18,990,340	£15,192,272
Total ..	£262,737,958	

This total, capitalised at, say 30 years' purchase, would give 7,890 million pounds sterling as the national value of rateable or fixed property. This does not, of course, include goods and chattels and all moveable properties, which are generally insured against fire. If these were taken at the same figure—they would probably exceed this—the value of national property, fixed and moveable, would be 15,780 millions. Deducting one-third for contingencies, such as uninsured values, it would still leave in round figures 10,000 million pounds sterling as the value of property insured. That would represent ten times the value insured in the metropolis, and as this is also the relative proportion in population between London and the whole

country, it would indicate a likelihood of these figures being fairly accurate. They may, at any rate, be used as the basis of some calculations which will be made with the view of estimating the effect of the suggested tax.

Appendix C (p. 380) shows that the cost of fire brigades in six towns, with a combined population of 6,177,323, and rateable value of £47,432,964, is £324,873 per annum, representing a rate of 1·60d. in the £. The rateable value of England and Wales, including the metropolis, is £180,406,420. Taking it at £220,000,000 for the United Kingdom, and assuming that under compulsory laws the cost of maintaining fire brigades would represent a rate of 1·50d., the total cost would be £1,375,000 per annum. To meet half this amount would require a contribution of £687,500. The contribution of £35 per million in London is nearly ¾d. per £100 insured; and ¾d. per cent. on 10,000 millions sterling insured would produce £312,500; 1½d. per cent. on 10,000 millions sterling insured would produce £625,000; 2d. per cent. on 10,000 millions sterling insured would produce £833,333.

The returns of some insurance companies seem to show that the value taken, 10,000 million pounds sterling, has not been over assessed. The premium income of 44 British fire offices last year was returned at £20,440,000. Asuming that this was on 10,000 million pounds sterling, it would roughly show an average premium of 4s. per cent., and that is probably above the general average of fire insurance rates. It should be borne in mind, too, that the 44 companies do not represent all the insurance offices, and therefore the whole income by way of premiums has not been brought into account.

Against the imposition of such a tax, it has been urged that insurance rates would be increased. One object of this paper is to determine the proper source from which the necessary funds should be obtained, and the question should be approached without any apprehension as to a possible increase in tariff. Insurance rates are, primarily, matters for consideration between the companies and their policy-holders. It would, however, appear evident that any addition must necessarily be slight, for it has been shown by the foregoing figures that an infinitesimal increase would produce a very substantial fund. As bearing upon this matter, attention might be directed to Appendix D, which gives in tabulated form the returns of British fire insurance companies for five years. The annual averages for that period are:—Premium income, £19,770,758; losses, £11,949,969; expenses, £6,763,162: funds, exclusive of capital, £30,034,228; paid-up capital, £8,379,698. The average annual losses amount to 60·44 per cent. of the premiums, expenses to 34·20 per cent., together 94·64 per cent. The remaining 5·36 per cent. represents a sum of £1,057,627, or 12·62 per cent. on the paid-up capital. In addition to this, it is to be presumed that the funds are available for investment, as all expenses and losses are shown as paid out of premium. Those funds at 2½ per cent. would produce £750,855 per annum which, together with the excess of income, over losses and expenses, gives a return of 21·58 per cent. on paid-up capital. With a huge premium income, large funds, and a return exceeding 20 per cent. on capital, insurance companies are in a position to meet such a tax as that suggested. Moreover, they reap advantages from the constantly increasing duties which are placed upon local authorities in the matter of prevention of fire. With compulsory laws, to enforce the provision of efficient preventive and protective measures in all districts, it is not unreasonable to expect these companies to bear an equitable share of expenses incurred by public bodies, in carrying out work which undoubtedly diminishes the risks of the insurers.

Indeed, it can scarcely be seriously maintained that insurance companies do not receive benefits from the efforts of fire brigades. A return of property at risk and lost by fire is shown in Appendix E (p. 380). These figures give the average annual fires, risks, and losses in the nine towns mentioned, for varying periods from 1 to 20 years. They show that in 3,437 fires per annum, the average amount at risk has been £10,837,631, whilst the total average annual losses have been only £515,398. A great proportion at any rate of the remaining £10,322,233 may be considered as "saved" for the benefit of owners and their assurers. Some of the evidence given before the Special Committee of the House of Commons, emphasizes this fact. For instance, in Exeter, the average loss per annum, before the organisation of the fire brigade, was £20,000. In 1898, out of £18,520 value at risk, only £314 was lost.

It appears that formerly fire brigades were maintained by insurance companies, but the responsibility has been gradually relinquished

In some towns, contributions of a voluntary kind are still made by the companies toward the support of fire brigades. The answers received to Question 6 in Appendix B, show that different customs prevail in this matter. The reply from Manchester implies that the arrangement made there is of an exceptional and confidential kind. From the Appendix No. 3 to the committee's report on fire brigades, it seems that the contributions of insurance companies to the Manchester fire brigade amounted in 1898 to £2,000 out of a total expenditure of £16,640, or 12 per cent., and represented a rate of one-sixth of a penny. The replies from Chicago and Berlin also contain interesting references to this subject, and are included in Appendix B (p. 379).

Perhaps it should here be explained that Appendix B has been compiled from replies received to inquiries made of some of the principal municipal authorities in this country, and from similar replies received from the authorities of New York, Chicago, Paris and Berlin. This part of the Appendix contains much useful information as to the measures for protection from fire taken in various English towns, and in the foreign cities mentioned.

General Remarks.

The reports of the chief officers of fire brigades display great dissimilarity in the manner of their compilation. Some are apparently prepared with the view of showing loss of life only, in others prominence is given to the loss of property and the value saved. The causes of fires are not always classified under similar heads. For these reasons it is not possible to prepare any general summary of statistics as to fire. Included in any legislation should be arrangements for some central department for the collation of reports and statistics. A marked feature in most reports, is the large number of fires in private dwellings, thus :—

Year.	Town.	Total number of fires.	Total number in private dwellings.	
1901	London ..	3,684	1,005	Average percentage of fires in private dwellings 38 percent.
1901	Glasgow ..	759	364	
1901	Liverpool.	749	324	
1901–2	Edinburgh	410	215	
1901	Dublin ..	127	49	
1901	Paris	1,422	788	

It is noticeable, also, that a large proportion of these fires are caused by defects in construction of fireplaces and flues. A central statistical department could, with advantage, in such cases, keep records of whether such defects are in buildings which have come under the operation of building by-laws or not, whilst it would be the duty of the fire inspectors, before alluded to, to report upon these defects, and suggest remedies for the prevention of a recurrence of fires. Possibly, too, the inspectors might be entrusted with the investigation of the causes of fires, as is done in the Fire Marshal's Bureau of the City of New York, referred to in a letter from the Fire Department of that city. (Appendix B. p. 379.)

The question of the proper equipment of fire brigades is a matter for the consideration of the executive officers who administer the statutory regulations relating to fire. It is not possible to specify in legislative enactments the exact equipments that are necessary under varying circumstances. But by making all laws compulsory, the work of the executive officers would be materially facilitated. It may here serve some useful purpose to attach a comparative statement of the cost of fire brigades, per head of population, in London, and in the foreign cities included in returns of Appendix B.

Cities.	Population.	Cost of brigade per annum.	Cost per head of population. s. d.
London ..	4,536,063	£291,580	1 3
New York.	3,444,675	5,313,000 dols.	6 5
Paris	2,511,629	2,729,092 francs.	10
Berlin	1,864,203	1,796,066 marks.	1 0
Chicago ..	1,750,000	1,800,000 dols.	4 2

New York spends the greatest sum per head and Paris the least. There has been a constant growth in the number of fires in the French capital. In 1841 one fire occurred every 43 hours during the year, in 1860 one in every 19 hours, in 1879 one in every ten hours, and in 1901 one in every 6 hours. The population between 1841 and 1901 trebled, but fires were seven times as numerous in the latter year. It should be mentioned that the Paris fire brigade is partly under military control. (See letter from the Prefect of Police, Appendix B. p. 378.)

There are subsidiary questions in relation to the subject which should receive attention in any legislative steps that may be taken, such as the protection of the uniform of fire brigade men, as has been done in other services by the

Uniforms Act, 1894; as to the desirability or otherwise of the employment of the police as firemen, and the bearing of the Police Act, 1893, upon this matter. There are also questions of administration which would call for attention, such as the position which efficient volunteer brigades should take under any amended laws; and, in any consideration of this wide subject, importance should be attached to the desirability of securing by law that school children are taught how to act in outbreaks of fire, and in times of general panic. Numerous instances could be cited of many lives having been saved through the timely action of a self-possessed and resourceful head, and medical men uphold the opinion that it is possible to train the human mind to act with promptness, and yet without loss of nerve, in the most trying circumstances. The school is the place best adapted for such training, and it may be possible to obtain by new fire laws some power to bring about this desirable end.

From this hurried *resumé* of the steps taken up to the present time by the Legislature and local bodies in the matter of protection from fire, it will be observed that the enactments at the outset are vague and scattered. In recent years the legislative steps seem to point to efforts for dealing with the question with thoroughness and exactitude. But, owing to the fact that the various statutes relating to the subject are contained in Acts from 1833 to 1901, it has become imperative that the laws appertaining thereto should be consolidated, that is to say, existing enactments should be repealed, and one Act obtained embodying provisions as to what has been found to be of value. Should such a proposal commend itself to the Government for the time being, it will no doubt be found desirable to appoint a committee of inquiry. Amongst other matters for consideration, would be some of those herein referred to, which include :—

I. A general inquiry into fire preventive laws, as distinct from laws as to fire extinction, and as to any modification required in the powers given local authorities to make by-laws for the prevention of fire in buildings.

II. Whether, and if so, to what extent it is expedient to make the laws and by-laws in relation to protection from fire retrospective.

III. As to the desirability of appointing fire inspectors, their qualifications, duties, and as to the areas to be placed under their charge.

IV. As to the necessity of amending laws in relation to the conveyance, storage, and sale of inflammable goods, and more particularly whether existing laws can be amended or new ones framed which will tend to reduce the number of lamp accidents.

V. As to the desirability of amending the laws dealing with the protection from fire of theatres and other places of public resort.

VI. As to the necessity of repealing existing laws and of making all laws relating to protection from fire compulsory; also of obtaining by law contributions from insurance companies and owners, toward expenses incurred in the protection of property from fire.

VII. As to the need of creating a public fire department, to inspect the steps taken by local authorities, to compile statistics as to fire, and generally to supervise the administration of fire laws.

VIII. A general consideration of the report of the Select Committee on Fire Brigades, dated 16th July, 1900, and the recommendations therein contained.

IX. Subsidiary questions, such as :—

(*a*.) The position of efficient volunteer fire brigades under the proposed amended laws.

(*b*.) The fire protecting measures adopted in foreign countries.

(*c*.) The desirability of training school children how to act in time of panic, and in outbreaks of fire.

(*d*.) Questions of general administration.

In the course of this essay it has been necessary to criticise the administration of voluntary fire brigades. Those remarks have not been made with any intention of depreciating the gallant services rendered by fire brigade volunteers; nor is it sought to deprive volunteers of honour which is rightly theirs, by reason of many deeds of valour done in times of extreme danger. The exigencies of the time, however, demand that fire brigades shall be placed under the direct control of public bodies. That such a change need not detract from personal bravery is amply proved by the past history of such brigades, whose members, though "paid men," have acted in times of peril from the highest motives only, and have ever been ready, under all circumstances, to promptly answer to the stern call of duty.

APPENDIX A.

An Abstract of the Laws in Relation to Protection from Fire.

The Lighting and Watching Act, 1833.—(3 and 4 Will IV., c. 90.)—Inspectors are authorised to provide and keep up fire engines, with pipes and other utensils for the use of the parish adopting this Act. They may also provide a proper place or places for keeping such engines, place same under the care of proper person or persons, and make allowance for his or their trouble. (Sect. 44.)

Remarks.—The present authorities for executing the Act are the parish council under the circumstances mentioned in Section 7 (5) and (7) of the Local Government Act, 1894, in other cases the inspectors, unless an order is made by the county council under Section 19 (10) of the Local Government Act, 1894, or unless the inspectors or a parish meeting transfer the powers of the former to the parish council, under Section 53 (1) of the Local Government Act, 1894.

The Waterworks Clauses Act, 1847 (10 Vict. c. 47).—Sections 38-42, enact that the undertakers shall, at the request of the town commissioners, fix proper fire-plugs in the main and other pipes at certain prescribed distances and places, and such main must be kept charged with water under pressure, unless prevented by frost, unusual drought, or other unavoidable cause or accident, or during necessary repairs, without charge, for fire extinction purposes.

Remarks.—The Act applies only to waterworks authorised by Acts of Parliament, which incorporate the provisions of this Act, and which have been passed since 23rd April, 1847.

The Town Police Clauses Act, 1847 (10 and 11 Vict. c. 89).—Section 30 imposes a penalty upon every person who wilfully sets, or causes to be set, on fire any chimney. Section 31 enacts that if any chimney accidentally catch fire, the person occupying the premises shall be liable to a penalty, provided such fire was in no wise owing to omission, neglect, or carelessness of himself or servant. Section 32 enacts that "The Commissioners may purchase or provide such engines for extinguishing fire, and such water buckets, pipes and other appurtenances for such engines, and such fire escapes and other implements for safety or use in case of fire, and may purchase, keep, or hire, such horses for drawing such engines as they think fit, and may build, provide, or hire places for keeping such engines with their appurtenances, and may employ a proper number of persons to act as firemen and may make such rules for their regulation as they think proper, and give such firemen and other persons such salaries and such rewards for their exertions in cases of fire as they think fit."

Remarks.—These Sections (30-33) are incorporated with the Public Health Act, 1875 (Sect. 171). The effect of Section 33, providing for engines being sent beyond the limits of the Act, at expense of owner, has been modified by (61 and 62 Vict. c. 38). See note on that Act,

The Poor Law Amendment Act, 1867 (30 and 31 Vict. c. 106).—This Act provides that if the vestry of any parish where there is no town council, local board, or other authority competent to provide the same, shall so resolve, the overseers shall provide any fire engine, ladder or fire escape for general use in the parish, and pay out of the poor-rate the cost thereof and for maintenance of same.

Remarks.—The Act has practically been superseded by others and proceedings cannot be taken under it in any area of which the rural district council has been invested with the powers of Section 171 (2) of the Public Health Act, 1875, nor in any area in which Section 44 of the Lighting and Watching Act, 1833, is in force. The parish council now executes the Act in all parishes having such a council. Section 6 (1.) (c.) (ii.) of the Local Government Act, 1894 and the overseers in other parishes unless an order has been made under Section 19 (10) of the Act of 1894.

The Petroleum Act, 1871 (34 and 35 Vict. c. 105).—Section 4 enacts that every harbour authority shall frame and submit for comfirmation by the Board of Trade by-laws as to ships carrying petroleum. Section 6 enacts that vessels containing petroleum shall have attached thereto a label marked "highly inflammable." Section 9 stipulates the mode of granting licenses. Section 11 provides for testing petroleum by officers of local authority. Section 14 provides for the application of the Act to other substances. An order in council was made on the 26th February, 1898, applying the Act to carbide of calcium, and was modified as to small quantities of that substance on the 7th July, 1897.

Remarks.—The Petroleum Acts 1871-1881 are administered by the local authority as defined in Section 8 of the Act of 1871.

The Petroleum Act, 1879 (42 and 43 Vict. c. 47).—Section 2 alters the term contained in 34 and 35 Vict. c. 105, "petroleum to which this Act applies," so as to mean such petroleum defined by Section 3 of that Act as when tested gives off an inflammable vapour at a temperature of less than 73° Fahr.

Remarks.—The first schedule to the Act contains a specification of the test apparatus, and directions for applying the flashing test.

The Petroleum (Hawkers) Act, 1881 (44 and 45 Vict. c. 67).—Section 1 gives powers to any person licensed under the Petroleum Act 1871 to hawk such petroleum. Section 2 (1-9) specifies the regulations for hawking petroleum, and imposes penalties for contraventions of this section.

The Public Health Act, 1875 (38 & 39 Vict. c. 55).—Section 66 enacts that "every urban authority shall cause fire plugs and all necessary works, machinery and assistance for securing a sufficient supply of water in case of fire to be provided and maintained and for this purpose they may enter into any agreement with any water company or person." It is further stipulated that the urban authority shall denote the

situation of such fire plugs. Section 157 gives power to every urban authority to make by-laws. . . . . (2) With respect to the structure of walls foundations roofs and chimneys of new buildings for securing stability and the prevention of fires and for purposes of health. Section 163—By this section the Lighting and Watching Act, 1833, is superseded in any place which becomes constituted or included in any urban district, or which becomes subject to this enactment by virtue of any order of the Local Government Board. [See Lighting and Watching Acts 1833 (3 & 4 Will. IV. c. 90)]. Section 171 enacts that the provisions of the Town Police Clauses Act, 1847. . . . (2) With respect to fires, shall for the purpose of regulating such matters in urban districts be incorporated with this Act. [See Town Police Clauses Act, 1847 (10 and 11 Vict. c. 89 ss. 30-33)]. Section 202 enables a rural authority to form parochial committees. Section 233 empowers any local authority to borrow on credit of the rates and with the saction of the Local Government Board, for the purpose of defraying any costs charges and expenses incurred or to be incurred in the execution of the Sanitary Acts or of this Act. Section 285 gives power to execute works in adjoining districts and to combine for execution of works. By Section 276 the Local Government Board may invest rural authorities with powers of urban authority. Sections 299-302 set out the power of the Local Government Board to enforce performance of duty by defaulting local authority.

Remarks.—Sections 233 and 285.—It is considered that these sections may be properly applied to the provision of fire appliances.

The Public Health Acts Amendment Act, 1890 (53 and 54 Vict. c. 59).—Part III. Section 23 (1) enacts that "Section one hundred and fifty-seven of the Public Health Act, 1875, shall be extended to make by-laws with respect to. . . . . The structure of floors, hearths and staircases." Section 23 (3) empowers rural authorities to make by-laws with respect to structure of walls and foundations of new buildings. Section 36 (1-6) enacts that every building which is used as a place of public resort shall, to the satisfaction of the urban authority, be substantially constructed and supplied with ample, safe, and convenient means of ingress and egress. The remaining sub-sections provide for means of ingress and egress being kept free and unobstructed; for inspection by an officer of the urban authority, and as to penalties for contraventions of this section. The expression "place of public resort" is also defined. Part IV. (Music and Dancing) Section 51 (1-13). This part of the Act enacts that "For the regulation of places ordinarily used for public dancing or music, or other public entertainment of the like kind the following provisions shall have effect: Those provisions enable the Licensing Justices of the licensing district to grant licenses to keep or use houses, rooms, gardens, or places for all or any of the purposes aforesaid upon such terms and conditions, and subject to such restrictions as as they by the respective licenses determine, and every license shall be in force for one year or for such shorter period as the Justices shall determine. Parts III. and IV. of the Act of 1890, in which the above sections are embodied, are by Section 2 (2) of the Act declared to extend to any district in which they are respectively adopted under the provisions of this Act.

Remarks.—It is not definitely stated that these by-laws, made under Part III., Sect. 23 (1), are intended for the prevention of fires, as in Section 157 of the Public Health Act, 1875, but reading the two sections together the inference to be drawn is that they are so intended. Section 36 is presumably intended as a precaution against fire. The powers given in Part IV. have been applied in many districts for fire prevention purposes by including terms and conditions bearing on the subjects in the licenses granted.

The Police Act, 1893 (56 Vict. c. 10).—This Act provides that a police constable shall, for the purposes of the Police Act, 1890, be deemed to be in execution of his duty, where, in pursuance of any direction of the police authority, he acts as fireman in the extinguishment of fire or in protecting life or property from fire. The Act also contains provisions as to the administration of pensions and gratuities.

Remarks.—The Act is executed by the county council in counties and the town council in boroughs having a separate police force.

The Local Government Act, 1894 (56 and 57 Vict. c. 73).—As to alterations made in authorities executing (3 and 4 Will. IV. c. 90) and (30 and 31 Vict. c. 106) see those Acts above. Borrowing powers are conferred upon parish councils by Section 12. The county council or a parish council may apply to the Local Government Board for an Order under Section 276 of the Public Health Act, or by any enactment apply that section, to confer urban powers upon a rural district council. Sect. 25 (7). The parish council may be invested with any power which under the Public Health Act, 1875, might be delegated to a parochial committee (Sect. 15). Two or more parish or district councils or both may combine for the purpose of appointing a joint committee for any purpose in which they are jointly interested (Sect. 57). Supplemental provisions as to the adoptive Acts are contained in Section 53.

The Uniforms Act, 1894 (57 and 58 Vict. c. 45).—This Act provides that it shall not be lawful for any person not serving in His Majesty's military forces to wear without permission the uniform of any of those forces and imposes a penalty for bringing contempt upon that uniform.

Remarks.—This Act is cited as it may be found expedient to similarly protect the uniforms of fire brigades.

The False Alarms of Fire Act, 1895 (58 and 59 Vict. c. 28).—Any person knowingly giving or causing to be given a false alarm of fire to the fire brigade shall be liable on conviction to a penalty not exceeding twenty pounds (Sect. 2).

The Parish Fire Engines Act, 1898 (61 and 62 Vict. c. 38).—The Act enables a parish council to agree with the council of any neighbouring borough or district that any fire engines with their appurtenances and firemen provided by the council of that borough or district shall be used for extinguishing fire in the parish. Sect. 1 (1).

The owner of lands and buildings where the fire occurred, where fire engine is sent beyond the limit of a borough or district in pursuance of such agreement, shall not be liable for any expenses or charge under Section 33 of the Town Police Clauses Act, 1847.

The Factory and Workshop Act, 1901 (1 Edw. VII. c. 22).—Section 14 (1-8). Sub-section (1). Every factory of which the construction was not commenced on or before the 1st January, 1892, in which more than 40 persons are employed, and every workshop of which the construction was not commenced on or before the 1st January, 1896, and in which more than 40 persons are employed, must be furnished with a certificate from the district council, that the factory or workshop is provided with such means of escape, in case of fire, for the persons employed therein, as can reasonably be required under the circumstances of each case; and it shall be the duty of the council to examine every such factory and workshop, and on being satisfied, to give such certificate, which must specify in detail the means of escape so provided. Sub-section (2). It shall be the duty of the district council to ascertain whether all factories and workshops are provided with such means of escape as aforesaid, and in the case of any factory or workshop not so provided, to serve on the owner a notice requiring him to carry out the specified measures necessary. The owner shall, notwithstanding any agreement with the occupier, have power to comply with the requirements. Sub-section (3). Arbitration clause in the event of difference of opinion between owner and the council. Sub-section (4). Power of owner if he alleges that occupier ought to bear or contribute to expenses, to apply to county court. The court may make such order as appears just, and equitable under all the circumstances of the case. Sub-section (5). Power of inspector to give like notice and take like proceedings as with respect to matters under the law relating to public health. Sub-section (6). Means of escape to be maintained in good condition and free from obstruction. Sub-section (7). The whole of a tenement factory or workshop shall be deemed to be one factory or workshop, and the owner shall be substituted for the occupier for purposes of this section. Sub-section (8). As to defraying expenses incurred by district council in the execution of this section. Section 15. Power conferred upon every district council to make by-laws providing for means of escape from fire in any factory or workshop (Sections 182 to 186 of the Public Health Act to apply to such by-laws). Section 16. (1) Doors of factory or workshop or any room therein must not be locked or bolted or fastened so that they cannot be easily and immediately opened from the inside, while any person is employed or is within for the purpose of employment or meals. (2) Doors of each room in which more than ten persons are employed shall, except in case of sliding doors, be constructed so as to open outwards. Section 135. (1) The occupier of a factory or workshop not kept in conformity with this Act, shall be liable to a fine not exceeding £10, and, in a second or subsequent conviction, if within two years of last conviction for the same offence, not less than £1 for each offence. (2) The court may order certain means to be adopted for the purpose of bringing the factory or workshop into conformity with the Act. Section 136. If any person is killed or dies, or suffers any bodily injury or injury to health in consequence of occupier having neglected to observe this Act, the occupier shall be liable to a fine not exceeding £100, and in a second or subsequent conviction within two years from last conviction for same offence, not less than £1 for each offence and the whole or part of fine may be applied for the benefit of injured person or his family, or as the Secretary of State determines.

Remarks.—Section 16 (2) applies only to every factory or workshop the construction of which was not commenced before January 1st, 1896. Section 136 emphasises what has been observed in Essay, as to the protection afforded by the State to the health and life of its individual members.

APPENDIX B. (PART I.)

RETURNS RECEIVED FROM THE TOWN CLERKS OF VARIOUS BOROUGHS IN THE UNITED KINGDOM, AS TO THE MEASURES TAKEN IN THEIR RESPECTIVE TOWNS FOR PROTECTION FROM FIRE.

QUESTION I.—*Are any Local Acts for Fire Protection in force, if so, please specify briefly?*

The above question was addressed to the Town Clerks of various boroughs, and the following are copies of the replies received:—

London.—The Fire Brigade Act, 1865.

Glasgow.—The fire brigade of the city of Glasgow is constituted by the Glasgow Police Act, 1866, 29 and 30 Vic. c. 273, and the provisions of that Act were amplified in the Glasgow Corporation and Police Act, 1895, 58 and 59 Vic. c. 143.

Edinburgh.—Yes. The City Acts of 1879 and 1891.

Dublin.—Dublin Corporation Fire Brigade Act 1862, 25 Vic. c. 38.

Belfast.—Yes. 8 and 9 Vic. c. 142. (1845.)

Sheffield.—No.

Hull.—No.

Brighton.—No.

Sunderland.—No; only the General Acts.

West Hartlepool.—The West Hartlepool Local Act contains provisions for the Corporation constituting a fire brigade and making the necessary provisions for fire engine, &c.

Lewes.—No.

QUESTION II.—*Under what Acts have Building By-laws relating to Fire Prevention been adopted?*

The above question was addressed to the Town Clerks of various boroughs, and the following are copies of the replies received:—

London.—No by-laws have been adopted, but the London Building Act, 1894, contains, among other provisions, some designed with a view to the prevention of the spread of fire in buildings. The same remark applies to some of the provisions of the Factory and Workshop Act, 1901. A copy of the Council's requirement under this Act is sent.

Glasgow.—The Glasgow Building Regulation Act, 1892, 55 and 56 Vic. c. 239, and the Glasgow Building Regulations Act, 1900, 63 and 64 Vic. c. 150. The 1892 Act has been repealed by the 1900 Act, but the by-laws framed under the 1892 Act are still in force.

Edinburgh.—Building rules have been passed under the City Acts of 1891 and 1893.

Dublin.—Public Health and Corporation Act, 1890, 53 and 54 Vic. c. 246.

Belfast.—Local Acts and Public Health (Ireland) Acts.

Sheffield.—The Public Health Act, 1875.

Hull.—Our building by-laws are made under the Public Health Acts.

Brighton.—Public Health and Local Acts.

Sunderland.—The Public Health Act.

Lewes.—The only by-laws with respect to buildings are those of the Local Government Board relating to new streets and buildings.

QUESTION III.—*Are Fire Precautions inserted in Licenses for Theatres, Dancing-rooms, &c., and by what authority are such Licenses granted?*

The above question was addressed to the Town Clerks of various boroughs, and the following are copies of the replies received:—

London.—Yes. Licenses are granted by (*a*) The Lord Chamberlain, and (*b*) The London County Council.

Glasgow.—In connection with the licenses of theatres and music halls in Glasgow, special by-laws have been framed, which include numerous by-laws in regard to protection from fire. Those licenses are granted by the Magistrates of the City, acting under the powers contained in the Glasgow Police (Further Powers) Act, 1892, 55 and 56 Vic. c. 165.

Edinburgh.—Yes. Granted by Justices of the Peace.

Dublin.—Patents for theatres granted by Lord Lieutenant. Construction and provi-ions against fire controlled by Department of Public Health.

Belfast.—Such establishments do not require license from the Corporation. The Lord Mayor gives permission for theatrical performances (under local Act). (Part IV. of the Public Health Acts (Amendment Act) 1890 not adopted here).

Sheffield.—Yes. Licenses for theatres are granted by the city council. Licenses for dancing are granted by the magistrates.

Hull.—Yes. See rules sent herewith. Licenses for theatres are granted by the licensing committee appointed by the council—in other cases by the licensing justices.

Brighton.—The Corporation only grant licenses for the performance of stage plays under 6 and 7 Vic., c. 68 and Local Government Act, 1888. No fire precautions are inserted in such licenses, but before the license is granted the borough surveyor reports as to whether the building is one in which stage plays should be permitted to take place, and as to what arrangements have been made as to exits, &c., in case of fire.

Sunderland.—Theatre licenses are granted by the Council (acting by the Watch Committee), and before being issued inspection is made by the borough surveyor and his requirements as to fires are complied with. Dancing licenses are granted by the justices.

West Hartlepool.—Police.

Lewes.—No.

QUESTION IV.—*Is the Fire Brigade a Police Establishment, or how constituted, and under what Acts?*

The above question was addressed to the Town Clerks of various boroughs, and the following are copies of the replies received:—

London.—No. The brigade is constituted under the Fire Brigade Act, 1865.

Glasgow.—The fire brigade is constituted under the Glasgow Police Act, 1866, above referred to. It is not a police establishment in the sense of being worked by members of the police force. The staff is one solely employed in fire brigade duty.

Edinburgh.—Fire brigade is a separate establishment distinct from the police service. The authority for its constitution will be found in the City Act of 1879.

Dublin.—A municipal force exclusively for fire protection (25 Vic. c. 38). Police not under control of Corporation.

Belfast.—Provided and maintained by the corporation under Local Act. (*See* reply to No. 1.)

Sheffield.—It is a police establishment. The Town Police Clauses Act, 1847.

Hull.—The fire brigade is a police establishment.

Brighton.—There is a police fire brigade in addition to a volunteer fire brigade. Towns Police Clauses Act, 1847.

Sunderland.—It is part of the police establishment under the General Acts.

West Hartlepool.—Brigade allowance of 2s. 6d. for drill each month and a retaining fee of £1 per annum. Fee attending fire 4s. 6d. per hour.

Lewes.—Volunteer fire brigade.

QUESTION V.—*Is the Fire Brigade supported entirely from the rates, if not, what proportion from other sources, and what sources?*

The above question was addressed to the Town Clerks of various boroughs, and the following are copies of the replies received:—

London.—No. H.M. Government contribute £10,000 a year, and fire insurance companies contribute.

Glasgow.—The fire brigade is supported from the police rates of the city, with the addition of sums received for attending fires. In the case of fires occurring within the city, the proprietor and occupier of every land or heritage in which the fire breaks out are jointly and severally liable to pay, as a contribution towards the expenses of the brigade turning out, the sum of fifteen pounds (£15), or whatever less sum is equal to one-half of the expenses; and in the case of fires occurring beyond the city boundary, the proprietor and occupier are jointly and severally liable to pay the whole expenses, attending the fire, with the addition of a sum not exceeding 25 per cent. on the amount of the said expenses, as shall be fixed by the magistrates and council, as a reasonable contribution in respect of the tear and wear of the engines, &c.

Edinburgh.—The whole cost of the brigade is borne out of the local rates.

Dublin.—Yes. 2½d. in the pound on valuation.

Belfast.—Rates and contributions from fire insurance companies towards expenses incurred at fires, *i.e.*, expenses over and above the ordinary outlay for maintenance.

Sheffield.—It is supported entirely from the rates.

Hull.—The fire brigade is supported entirely from the rates.

Brighton.—The police fire brigade is supported entirely from the rates, and the rent of the premises occupied by the volunteer fire brigade, and the salary of their station-keeper are also paid out of the rates.

Sunderland.—Practically so.

West Hartlepool.—Yes.

Lewes.—The Corporation make a grant of £50 a year for the support of the brigade, in addition to the grant the Corporation provide and maintain all plant and appliances.

QUESTION VI.—*Kindly state if Insurance Companies subscribe to the Fire Brigade, and what proportion of total expenses, and cost of up-keep of Brigade.*

The above question was addressed to the Town Clerks of various boroughs, and the following are copies of the replies received:—

London.—Fire insurance companies contribute at the rate of £35 per million of the gross amounts insured by them in respect of property in London. The contributions amounted in 1901-2 to £31,731. The gross expenditure on the maintenance of the brigade that year was £213,820, and the net amount raised from the ratepayers was £163,112.

Glasgow.—In the case of premises which are insured, such payments are, of course, made by the insurance companies; but beyond that, the insurance companies do not make any contribution to the up-keep of the brigade.

Edinburgh.—Insurance companies do not contribute towards the cost.

Dublin.—Do not subscribe any portion of the expense. (See Report (No. 216) enclosed, referring to this subject).

Belfast.—Contributions from fire insurance companies towards expenses incurred at fires, *i.e.*, expenses over and above the ordinary outlay for maintenance, about £9,500 is the cost of the brigade.

Sheffield.—There is no definite arrangement as to this, but several insurance companies contribute towards the expenses of the fire brigade.

Hull.—Insurance companies do not contribute towards the expenses of the fire brigade, but an effort is now being made to induce them to do so.

Brighton.—The insurance companies do not subscribe to the cost of maintaining the Police Fire Brigade. Cost of up-keep for year ending March, 1901, £1,488, including £62 5s. 10d. rent of premises occupied by the Volunteer Fire Brigade, and £78 salary of station-keeper of Volunteer Fire Brigade Station. Copy of last Police Fire Brigade report is sent herewith.

Sunderland.—Some of the companies contribute a small sum in cases of fire where they are interested. My Corporation have moved in favour of compulsory contribution by the companies towards the maintenance or otherwise of fire brigades as in London and other places, but, so far, owing to opposition, little advance has been made.

West Hartlepool.—Yes, usually one half.

Lewes.—One or two companies subscribe a guinea or two a year. Insurance companies generally pay the brigade for services at fires.

Manchester.—The case of Manchester on the subject of the expense of maintaining the fire brigade is believed to be somewhat exceptional, the powers of the Corporation being chiefly contained in Local Acts, which may be consulted in the Manchester Municipal Code, Volume I. pp. 67-76. In consequence of the existence of the local provisions, the Corporation have made certain arrangements with the association of insurance companies, but as they are of a special and confidential nature, I am not at liberty to furnish you with the particulars.

APPENDIX B. (Part II.) FOREIGN.

Copy of correspondence with the authorities of foreign cities as to the measures taken in those cities for protection from fire.

[Copy of Letter of Enquiry].

Uckfield, England,
Monday, 18th August, 1902.

Dear Sir,—

Would you be kind enough to supply me with the particulars asked for in the following questions, as to the provisions made by the public authorities in Berlin, for protection from fire:—

(1.) Are any laws in force giving control over the construction of buildings, with the object of preventing fires?

(2.) Is the fire brigade maintained out of public funds?

(3.) Is the fire brigade under police control, or is it a special branch of the public service?

(4.) Do fire insurance companies subscribe towards the expenses of extinguishing fires, and, if so, to what extent; and is this a voluntary subscription or one enforced by law?

(5.) What is the approximate cost of the fire brigade in Berlin, per annum?

(6.) Are there compulsory laws for prevention of fires in Germany, generally, or is the provision of fire brigades made by voluntary efforts?

If you would let me have answers to the above questions, I would deem it a great favour.

I am, dear Sir, Yours faithfully,
(Signed) T. B. PHILLIPS.

The Town Clerk, or Chief Magistrate, of Berlin.

(Similar enquiries were sent to Paris, New York, and Chicago.)

[Copy of Letter from Berlin.]

Berlin, den, 7 September, 1902.

In Beantwortung der in dem gefälligen Schreiben vom 18. v. Mts. gestellten Anfragen theilen wir Ihnen ergebenst Folgendes mit.

Zu 1. In Deutschland bedürfen alle Bauten der polizeilichen Prüfung und Genehmigung. Für Berlin enthält die Baupolizeiordnung vom 15 August, 1897, die entsprechenden, auch auf die Verhütung von Feuersgefahr bezüglichen Vorschriften.

Zu 2. Das hiesige (Berufs-) Feuerwehrcorps wird aus städtischen Mitteln unterhalten;

Zu 3. Die Verwaltung des Feuerlöschwesens hierselbst bildet eine besondere Abtheilung des Königlichen Polizei Präsidiums;

Zu 4. Zu den Kosten des hiesigen Feuerlöschwesens trägt die städtische Feuer-Societät nach Maassgabe des Feuer-Societäts-Reglements vom 1 Mai, 1794, welches gesetzliche Kraft hat und die Vergütung von Feuerschaden an Gebäuden regelt, etwa zur Hälfte bei.

Zu 5. Für das Rechnungs jahr, 1902 sind die Ausgaben für das Feuerlöschwesen auf 1,796,066 Mark veranschlagt worden.

Zu 6. Die Verpflichtung eines jeden Staatsbürgers zur Hilfeleistung bei Feuergefahr beruht auf gesetzlicher Vorschrift. In Deutschland giebt es Berufsfeuerwehren, die aus allgemeinen Mitteln unterhalten werden, und an Orten, an denen solche nicht eingerichtet sind, neben der Pflichtfeuerwehr, der jeder Einwohner anzugehören hat, häufig freiwillige Feuerwehren. Die Unterhaltung der letzteren geschieht theils aus allgemeinen Mitteln, theils aus freiwilligen Beiträgen.

[Translation of Letter from Berlin.]

Berlin, 7th September, 1902.

In reply to the enquiries contained in your letter of 18th instant, we beg to inform you as follows:—

To (1). In Germany all buildings are required to undergo inspection, and be approved by the police authorities. For Berlin the regulations referring to the prevention of fire are contained in the Police Building Order of 15th August, 1897.

To (2). The fire brigades (professional) of this place are maintained by the municipality.

To (3). The management of matters relating to fire extinguishing in this place forms a special department of the Royal Police Presidency.

To (4). The Municipal Fire Society which possesses legal powers and controls the indemnification for damage by fire to buildings, contributes about one-half to the cost of fire extinguishing in this place, in accordance with the Fire Society's Regulations of 1st May, 1794.

To (5). For the financial year 1902, the disbursements in matters of fire extinguishing have amounted to M.1,796,066.

To (6). The duty of every State burgher to render assistance in case of fire forms the subject of a legal order. In Germany there are professional fire brigades which are maintained out of the general funds, and in places where such have not been organised, there are frequently, in addition to compulsory fire brigades to which each inhabitant must belong, voluntary fire brigades. The maintenance of the last-named is partly out of general funds and partly by voluntary contribution.

[Copy of Letter from Paris.]

République Française.
Liberté, Egalité, Fraternité.
Paris, le 27 Août, 1902.

Monsieur,—

Pour répondre au désir que vous m'avez exprimé, par votre letter en date du 18 Août courant, j'ai l'honneur de vous addresser ci joint:

1. La statistique des incendies et sauvetages pour lesquels le Régiment des Sapeurs-Pompiers de Paris á été appelé pendant l'année 1901;

2. L'ordonnance de Police du 1er 7bre, 1897, concernant les mesures préventives et les secours contre l'incendie dans la Ville de Paris.

J'ai l'honneur de vous faire connaître, en outre, que le Régiment de Sapeurs-Pompiers de Paris est plac

dans les attributions du Ministre de la Guerre pour tout ce qui concerne son organisation, son recrutement, le commandement militaire, la police intérieure, la discipline, l'avancement, les récompenses, les gratifications et l'administration intérieure.

Quant au service de secours contre l'incendie, il s'exécute sous la direction et d'aprés les ordres du Préfet de Police.

J'ajouterai que les compagnies d'assurances ne participent pas aux dépenses que nécessitent l'entretien du Régiment, qui sontà la charge de la Ville de Paris.

Agréez, Monsieur, l'assurance de ma considération la plus distinguée. LE PREFET DE POLICE.

[TRANSLATION OF LETTER FROM PARIS.]

SIR,— Paris, 27th August, 1902.

In accordance with the request contained in your letter of 18th instant, I enclose herewith :—

(1.) A statistical table of fires and salvage to which the regiment of Sapeurs-Pompiers of Paris was called during the year 1901.

(2.) The Police Order of 1st September, 1867, regarding preventive measures and assistance to be rendered in the case of fire in the city of Paris.

Further, I have the honour to inform you that the Paris Fire Brigade (Sapeurs-Pompiers) is placed within the jurisdiction of the Minister for War in all that relates to its organisation, enlistment, military command, internal police, discipline, promotion, rewards, gratuities, and internal management.

As regards the service for saving life at fires it is conducted under the direction and according to the orders of the Prefect of Police.

I may add that the expenses connected with the maintenance of the regiment do not form the subject of any contribution by the insurance compantes ; they are paid by the city of Paris.

Yours, &c., THE PREFECT OF POLICE.

[COPY OF LETTER FROM CHICAGO.]

Headquarters, Fire Department,
Chicago, Ill., Sept. 2, 1902.

DEAR SIR,—

Replying to your inquiry under date of the 18th ult., the following are answers to your questions in numerical order, viz. :—

In this city the Building Commissioner has control over the construction of buildings, with a view to the prevention of fires and loss of life.

The fire department is maintained by annual appropriation made by the City Council. (Board of Aldermen.)

The fire department is under the control of the Mayor and City Council, under the immediate direction of the Fire Marshal.

Foreign insurance companies pay a tax of 2 per cent. per annum towards the maintenance of the fire department, of which 25 per cent. is credited to the firemen's pension fund.

The approximate cost per annum of the fire department of this city is 1,800,000 dols.

There are compulsory laws in this city for the prevention of fires; see copy of building ordinances I send under separate cover; also throughout the United States generally.

Trusting the above information will be of some use to you, I remain, Yours very truly,

(Signed) W. H. HUSHAN,
Fire Marshal.

[COPY OF LETTER FROM NEW YORK.]

Headquarters Fire Department City of New York,
157 and 159, East 67th Street,
Borough of Manhattan,

SIR,— September 10th, 1902.

Your letter of the 18th ult., having been received by the City Clerk, was forwarded to this office for reply, and I am directed to furnish you the information asked for.

1. In reply to your first inquiry I have to say that the matter of the construction of all buildings used for other than tenements is under the jurisdiction of a bureau governed by a code known as the building code. The matter of the construction of houses used as tenements is under the jurisdiction of a separate department, known by the title "Tenement House Department."

2 and 3. The fire department is a distinct department maintained out of public funds, as are those above referred to. It is organised for the prevention and for extinguishing of fires. The fire department has three bureaus. One having control of all matters relating to the use, storage and handling of explosives, inflammables and other oils, and combustible material such as jute, cotton, hay, &c., and known as the "Bureau of Combustibles." A bureau for the investigation of the cause or causes of fires, known as the "Fire Marshal's Bureau." A bureau known as the "Bureau of the Chief of Department," the head of which has control of the uniformed force, the care of apparatus, horses and appliances, and the command at fires.

4. Insurance companies do not subscribe to the expense of the fire department. The payment of the cost of maintenance, &c., is provided by taxes.

5. The appropriation for the Fire Department of New York City for the year 1902 was 5,313,000·00 dollars. The estimated cost for the year 1903 is 5,264,000.00 dollars (this includes the appropriation and estimated cost for all the boroughs within the limits of what is known as Greater New York).

6. There are compulsory laws for the prevention of fire in most of the States, particularly those in which large cities are located.

Respectfully,
(Signed) JOHN R. SHIELDS, Asst. Secretary.

Note :—In response to further enquiries, Mr. Shields, on 20th February, 1903, kindly sent an "Extract of Chapter 466, Laws 1901, also Penal Code," defining the duties of the Fire Marshal. He remarks, "it may be noted that the head of the bureau has extensive powers."

APPENDIX C.

STATEMENT SHOWING COST OF MAINTENANCE OF FIRE BRIGADES FOR ONE YEAR IN SIX TOWNS, WITH POPULATIONS AND RATEABLE VALUES.

Towns.	Population.	Rateable Values.	Cost of Maintenance of Fire Brigade per annum.
	£	£	£
London	4,536,063	39,779,956	291,579
Manchester.................	543,969	3,109,690	16,640
Birmingham	522,182	2,348,858	11,188
Nottingham	239,384	907,000	2,763
Portsmouth	189,160	757,460	1,881
Sunderland.................	146,565	530,000	822
Totals........	6,177,323	47,432,964	324,873

APPENDIX D.

RETURNS OF FIRE INSURANCE COMPANIES FOR FIVE YEARS, 1898–1902, SHOWING PREMIUM INCOME, LOSSES, EXPENSES, PAID-UP CAPITAL, AND FUNDS.

Year.	Number of companies included in returns.	Premium income.	Losses.	Expenses.	Percentage on premiums.			Paid-up capital.	Funds, exclusive of capital.	Remarks.
					Losses.	Expenses	Total.			
		£	£	£				£	£	
1898	43	18,854,405	10,580,335	6,336,881	56·12	33·61	89·73	8,418,547	28,917,228	Returns taken from Whitaker's Almanac 1899–1903
1899	46	19,244,867	11,471,139	6,694,549	59·61	34·79	94·40	8,474,475	30,172,789	
1900	46	20,154,057	12,555,818	6,930,239	62·30	34·39	96·69	8,494,063	30,714,056	
1901	44	20,440,276	12,302,813	6,992,767	60·19	34·27	94·46	8,131,706	30,332,839	
1902	37	20,160,187	12,839,740	6,861,386	63·69	34·03	97·72	No return.	No return.	
Average		19,770,758	11,949,969	6,763,162	60·44	34·20	94·64	8,379,698	30,034,228	

APPENDIX E.

STATEMENT SHOWING AVERAGE ANNUAL VALUES OF PROPERTY AT RISK AND DESTROYED BY FIRES IN NINE TOWNS, AND AVERAGE NUMBER OF FIRES PER ANNUM.

Towns.	Period for which returns are taken.		Average number of fires per annum.	Average amount of property at risk per annum.	Average amount of property destroyed per annum.
				£	£
Glasgow	Ten years	1892–1901	648	2,750,000*	143,700
Liverpool	One year	1898	801	2,326,723	99,055
Manchester	One year	1898	495	1,650,425	71,606
Birmingham	Ten years	1892–1901	480	1,750,624	39,683
Edinburgh	One year	1902	393	1,095,040	79,751
Belfast	Ten years	1892–1901	176	729,700	48,855
Dublin	Twenty years ..	1882–1901	322	327,119	29,972
Brighton	Sixteen years ..	1886–1901	65	189,480	2,462
Exeter	One year	1898	57	18,520	314
			3,437	10,837,631	515,398

* Estimated amount of property at risk at Glasgow. In all other cases returns have been carefully kept by the various authorities.

[The thanks of the author are tendered to those public officials, at home and abroad, who courteously supplied some of the particulars embodied in the essay and appendices. He would specially mention the value of suggestions received from Mr. J. Meredyth Evans, Government Auditor of the Sussex District, Brighton.]

The CHAIRMAN said before asking the audience to discuss the clear and admirable paper read by Mr. Phillips, he would refer to circumstances under which the paper had been delivered. In connection with the Society of Arts there were various funds used for the distribution of prizes for many worthy objects. The present prize was duly advertised, and in response twelve papers, all of considerable merit, were sent in in competition. The Adjudication Committee consisted of Mr. Robert Gray, Mr. Alexander Siemens, and himself (Sir William Preece), and each member of that committee carefully and independently read through each paper, marking and criticising. The committee unanimously selected Mr. Phillips's paper as the best sent in. The author was the sanitary inspector to the Uckfield Urban District Council. It was quite clear that in discharging his duties in a small district council, he could not have acquired the experience which he had related, but he must have devoted a considerable amount of attention and labour to get together the statistics which he had quoted. Havtng regard to the high quality of the other essays, the Council decided to award two additional second prizes, and these were given to Mr. G. H. Paul, of Finchley, and Mr. W. Craig-Henderson, who each received a bronze medal and £10, Mr. Brice Phillips taking £50 and a silver medal. A fourth paper, sent in by Captain Shean was considered worthy of honourable mention.

Sir William then presented the Medals.

Mr. PAUL, before reading the following abstract of his paper, congratulated Mr. Phillips on the interesting contribution he had read, and said that if he wished to criticise it, it would be that he (Mr. Paul), would be more inclined to insist on the introduction of a measure into the House of Commons at once, rather than trust the matter to a Committee of the House. The question had been before Select Committees on many occasions previously.

EXISTING LAWS, BY-LAWS, AND REGULATIONS WITH REGARD TO FIRE PROTECTION.

ABSTRACT OF FOTHERGILL ESSAY (Awarded Prize of £10),

By GEORGE H. PAUL.

It is impossible to appreciate the present position of the law relating to fire protection without shortly reviewing the growth of legislation in relation thereto, and dealing separately with the matters of fire prevention and fire extinction, and in my essay I traced the law under those heads down to the present day. Here it is only possible to repeat the summaries I there gave as to the effect of the existing laws, by-laws, and regulations. With regard to fire prevention, London and the large cities of the United Kingdom have, by their special Acts, ample powers as to new buildings; all urban districts, *i.e.*, county boroughs, boroughs, and urban districts, possess the power of making provision for fire prevention so far as regards the structure of new buildings, but not their height or the means of escape therefrom in case of fire; and rural districts can, by obtaining the powers of urban authorities, place themselves in a position to exercise similar powers, while all local authorities can deal with factories and workshops where more than 40 persons are employed therein. These powers local authorities have carried out with varying degrees of efficiency. While some authorities insist on compliance with strict by-laws, others neglect to enforce the mildest regulations the Local Government Board sanction.

With regard to fire extinction throughout the United Kingdom, the provision of fire appliances, other than fire hydrants, is permissive, except where, under special Acts, the provision of adequate means of fire protection has become compulsory. Here again the practice of local authorities varies. In some districts the permissive powers are exercised to their fullest extent, in others they are unused. From the Report made by the Select Committee of the House of Commons on Fire Brigades in 1899, it appears that in England, outside the metropolis, there were only 750 fire escapes, that of 1,025 urban districts, 266 were without fire brigades, that 166 districts were returned as being without sufficient hydrants, and that 119 had defective water supplies. These unprotected districts had a population of about five millions, and a total rateable value of £1,250,000. Bearing in mind the enormous loss to the wealth of the country that even one year's fires represent, without considering the question of loss of life, one is struck with the seeming want of appreciation by the local authorities of the importance of this question. One fact tending to this neglect is doubtless the feeling, expressed by a writer on the duties of surveyors of local authorities, that too much interference is now made by sanitary authorities for the protection of property from fire, and that it is not a sanitary question, but one that chiefly affects insurance companies. Again it is held by many that the expense of the provision of fire appliances should be borne, at all events, in part by the insurance offices. Except in London and a few other cities regulated by special Acts, insurance offices, although they frequently pay, do not recognise the duty of

paying any part of the cost attending fires in a local authority's own district. As they profit by the work of local authorities, insurance offices should bear some part of the burden. That they should reap all the advantages of up-to-date fire equipment, and the local authority bear all the cost, is far from just. To suggest some equitable system by which the cost could be apportioned between the local authority and the insurance office is difficult, and that difficulty has strengthened the feeling in many minds that municipal insurance is the only practicable method of dealing with the matter.

Another factor tending to deter local authorities from making use of all their powers is the insufficiency of the water supply in many of the smaller towns and suburban districts. In 1899, as we have seen, no less than 119 urban districts in England were returned as having defective water supplies, and the ratepayer naturally asks what is the use of modern fire appliances and an active fire brigade if there is no water. The provision of a constant supply of water is of the utmost importance in fire extinguishing, and where a water company refuses to give such supply it is only reasonable that the local authority should without further procedure be entitled to construct waterworks under but not subject to the conditions of the Public Health Act.

It is clear that the time has arrived when an attempt should be made to deal with the question of fire protection in a systematic manner, and a general scheme framed such as will receive the support of public opinion and not cast too heavy a burden on the ratepayer. For this purpose fire authorities should be constituted for defined areas, so as to cover the whole of the United Kingdom. The area of the county is too large and that of the parish too small for the purpose, the only practicable unit being the city, the borough, the urban district, or the rural district. The council of all these areas is the sanitary authority charged with the duty of seeing that its district has an ample supply of water, and, except as to rural districts, charged with the duty of making by-laws with regard to new buildings, for their protection from fire, while all are authorities under the Factories and Workshops Act.

The first duty of such an authority should be to prevent, so far as possible, the erection of buildings which, by their method of construction, are a source of danger to a district. The citizens of London, when suffering under the influence of the great fire of 1666, at once determined to see that, in rebuilding their city, the evil which operated to cause the disaster should be removed, and in following these lines we cannot go far wrong. All existing laws with regard to new buildings, inspection of public buildings, and provision of fire appliances, should be repealed, except as to the metropolis and large cities having special Acts, and one measure passed dealing with all these matters. It should provide that every district council should be the authority charged with the duty of making by-laws for the prevention of fire, the inspection of public buildings, and the provision of proper means of escape, in case of fire, from all buildings (whenever erected) above a certain height. These powers should be set out in detail, and be of the fullest character. Every council should be empowered to appoint a fire officer whose duty it would be to examine all buildings and to see that the means of escape in case of fire were sufficient. In large districts this officer would be a trained fireman and the head of the fire brigade, in smaller districts the surveyor or engineer. Every council should be charged with the duty of fixing fire hydrants in the water mains and where no means exist of providing water vans or other receptacles available in case of fire and with the provision of fire appliances necessary and suitable to the district. Each council should appoint a fire committee, under whose direction the duty of fire protection would be placed, and such committee should establish or control a fire brigade with the fire officer at its head and permanent firemen or retained firemen as the circumstances of each case should justify. Two or three inspectors should be appointed by the Government (one of whom might be nominated by the insurance offices) whose duty it would be to examine periodically the fire apparatus of each district, to see the men at drill, and to give such advice as any brigade might require. The cost of this inspection would not be great and would be an equivalent for the benefit which the fire brigades manned by the police receive from the Consolidated Fund. Every council whose brigade should for the time being be certified as efficient should be entitled to charge the owner of the premises at risk, or the insurance office covering him, the actual cost of attending at a fire plus the sum allowed by the inspector as the tariff for the use of the council's fire appliances. This would be a rough but ready way of distributing the cost of fire extinction between the local authority and the insurance offices. The insurance offices

would be sure of an effective brigade, and owners, to cover themselves from the risk of payment for fire services, would insure. Provision should be made that every water company should give a constant supply of water, generally, or for fire purposes, at the risk on failure of being compulsorily purchased or having competitive works established by the local authority. This would be no injustice to the companies, as the safer life and property are, the greater the value of a district for trade and residence, and necessarily, the higher the profits of a water company. Such a scheme would, of course, put an end to volunteer fire brigades, and the whole cost of fire protection would be met out of the rates, less the sums received from insurance companies. The cost of properly protecting a district is not great. The London Act placed the maximum at a penny rate per year, and experience has shewn that, in properly managed districts, whether urban or rural, that amount is ample. The proposed Act should be divided into parts as was done with the Public Health Act, 1890, and its adoption, in whole or in part, made optional. This arrangement, while providing a general law, would not interfere with local self-government, each authority being able to adopt the whole or such parts of the Act as it thought best. Cities and boroughs, with special powers, not so extensive as the new Act, could adopt such of its provisions as they desired without losing their own rights, every authority being its own judge of what was best for its district, with the strongest inducement to take the fullest powers. An Act, framed on the above lines, would steer the middle course between the withholding of power on the one hand and compulsion on the other, and would, it is believed, be welcomed by all local authorities.

Mr. HENDERSON also read the following abstract of his paper:

EXISTING LAWS, BY-LAWS, AND REGULATIONS RELATING TO PROTECTION FROM FIRE, WITH CRITICISMS AND SUGGESTIONS.

ABSTRACT OF FOTHERGILL ESSAY
(Awarded Prize of £10),

BY W. CRAIG HENDERSON, D.SC.

In considering the extent and nature of the measures taken for the protection of life and property from fire, the author deals first with the subject of fire-prevention and then with the question of fire-extinction.

PREVENTION OF FIRE.

In rural districts where houses are widely scattered there is not much need for legislation on this subject, as each person can look after his own property, but in urban areas it is necessary to interfere to some extent with the freedom of action of private citizens by enforcing the observance of certain building regulations directed against the risk of fire. The following is a list of the principal statutes dealing with this subject:—

(*a*) For England: Towns Improvement Clauses Act, 1847, sec. 109; Public Health Act, 1875, secs. 157 and 182-184.

(*b*) For London: London Building Act, 1894, especially Part VI.

(*c*) For Scotland: Burgh Police (Scotland) Act, 1892, secs. 166-180 and Schedule IV.

Some other large towns besides London have private Acts, but instead of setting out all these Acts the author has chosen one—the most modern and seemingly the most thorough in its treatment of the question—for comparison with the London Building Act. Thus the final item in the list is

(*d*) For Glasgow: Glasgow Building Regulations Act, 1900, especially Parts VII. and IX.

After the effect of the provisions in the General Acts for England and Scotland named under (*a*) and (*c*) above, and of the model by-laws under sec. 157 of the Public Health Act, 1875, has been shortly stated, the London Building Act, 1894, is discussed, and by comparison with the Glasgow Building Regulations Act, 1900, it is shown that while the powers given by the London Act are fairly extensive, they do not go far enough. Thus the London Building Act makes no provision at all for hoists or elevators, although the great increase of buildings on the "flat" system makes this very necessary, especially since the occurrence of a serious fire a few years ago in Hyde Park Court, which originated in the passenger lift. The Glasgow Act contains a section (sec. 81) dealing specifically with precautions against fire in these structures. Again, none of the provisions of the London Act are made retrospective, while the Glasgow Act has important provisions relating to buildings whether erected before or after the passing of that Act.

A matter of supreme importance is

THE PROVISIONS OF MEANS OF ESCAPE IN CASE OF FIRE,

and the regulations bearing upon this subject are considered under three heads, according

as the buildings are—(1) Private Buildings; (2) Factories or Workshops; or (3) Theatres, Music-halls, or Public Buildings.

(1) A comparison is again made between the provisions of the London Building Act and those of the similar Act for Glasgow, the result being much in favour of the latter Act. In the matter of access to the roofs of buildings from the interior, the want of which access proved so disastrous in the fatal fire of last year in Queen Victoria-street, it is shown that while in London this is only required in certain specified cases which fail to cover a large number of buildings where human life would be endangered in case of fire, in Glasgow it is demanded of "every new and existing building." The regulations as to the provision of means of escape from high buildings, again, are identical in the two Acts, but in London they only apply to "new buildings"—*i.e.*, buildings erected after Jan. 1, 1895—while in Glasgow it is expressly provided that after the expiry of five years from the passing of the Act (30th July, 1900), they shall apply to existing buildings. Beyond this, the Glasgow Act has other important provisions not found in the London Act. (*Cf.* secs. 61 and 63 of the London Building Act 1894, with secs. 83 (2) and 111 of the Glasgow Act of 1900, and see the additional provisions in secs. 109, 110, of the latter Act.)

(2) The main part of the discussion of the regulations relating to factories and workshops is devoted to the failure of the Factory Act, 1901, to provide for the case where the provision of means of escape from a factory necessitates the entrance upon premises, not factories, and not occupied by the owner of that factory. To make such entrance would involve a trespass, and the local authority or umpire in arbitration proceedings, has no power to order such an Act. Mr. Tennant, M.P., introduced a Bill last year to amend the Factory Act so as to get over this difficulty, and the terms of his Bill are criticised by the author, to whom they appear to be open to grave objection. The remedy suggested by the author is, that the present distinction between "factory" and "no factory," so far as the question of escape from fire is concerned, should be wholly abolished, and that power should be given to local authorities to supervise all premises where trade or business is being carried on, and to enforce the provision of proper means of escape from fire. The two sections (109 and 110) of the Glasgow Act, which have no equivalent in the London Act, have been introduced for the purpose of providing for that large number of buildings where human life might be endangered, but which, not being factories, are not subject to the regulations of the Factory Act. Thus in Glasgow the distinction between the two classes of building is practically abolished.

(3) For the provision of means of escape from theatres and public buildings, it is shown that there is no public legislation in England, and only in private Acts are such regulations to be found. In Scotland, burghs which have no private Act have the requisite powers of supervision under the Burgh Police (Scotland) Act, 1892. Some local authorities have by-laws on the subject, and enforce them; others have none, while others again deal with each case as it arises. It is suggested that every local authority concerned should draw up and publish a list of regulations to be strictly enforced, so that the public may know that everything necessary has been done.

When the second part of the subject—Fire Extinction—is taken up, the main question for consideration is the constitution of

Fire Brigades.

The statutes bearing upon this matter both for rural and urban areas are named and their effect stated, and then the different kinds of fire brigade in the country are discussed—(1) professional; (2) police; (3) volunteer; (4) retained; and (5) private. The advantages and disadvantages of each kind are considered, and it is urged that it should be made a *duty* of urban authorities, and not only, as at present, a *power*, to establish a competent fire-brigade. Many urban areas are entirely without such protection; others are inadequately protected. The need for new legislation, consolidating and amending all the present enactments dealing with the subject, is pointed out, as some local authorities have been shown to be in ignorance of their statutory powers. Reference is made in this part of the essay to the report of the Select Committee on Fire Brigades (House of Commons Papers, No. 303, 1899). Most of the recommendations there made are approved of, but the suggestion made in connection with the official inspection of fire brigades, that the members of brigades reported efficient by inspecting officers should have certain privileges granted to them, is considered open to objection on the ground that the efficiency of a fire brigade can only be tested by its behaviour at actual fires, and cannot be determined by an examination in fire-drill.

This completes the general survey of the subject of Fire Protection, but, in conclusion, brief consideration is given to the regulations regarding two special fire risks—the use of electric light and the use of petroleum lamps.

Electric Wiring Regulations.

The fire-risk from the use of electric light would be practically non-existent if installations were always put up with the utmost care and best skill, but wiring is often done inefficiently, and fire-risks then appear. At the present day the difficulty is found, not in the absence of wiring regulations, but in their excessive number. Insurance companies all have sets of their own, and station-engineers, especially in municipal stations, add still further sets so that there is the utmost confusion, and in the end inefficient wiring is not detected till it is too late. The need for a uniform standard set of regulations is emphasised, and some further points of practical importance are discussed.

Petroleum and Petroleum Lamps.

Under this heading the author refers to the report of the London Fire Brigade for 1901, to show the large number of fires—some attended with loss of life—caused by mineral oil lamps, and he suggests that local authorities should urge Parliament to pass a measure embodying the recommendations of the Petroleum Committee of 1898 as to lamps.

The essay concludes with a summary of the author's suggestions.

DISCUSSION.

Mr. Edwin O. Sachs thought that thanks were due to the Chairman and his colleagues on the Adjudication Committee, for the great trouble they had taken in awarding the prize. Mr. Phillips's paper was most exhaustive and interesting, and would serve as a basis for much argument in the future. The arguments used might be summarised as a desire for the consolidation of the existing Fire Acts. The muddle that existed in some localities owing to the overlapping of the Acts named, as well by additional local Acts, By-Laws or Regulations was something terrible, and as an architect, he (Mr. Sachs) had constantly to meet with the difficulties due to the clashing of the numerous authorities which required to be consulted before a building could be put up which would be approved of by all the authorities concerned. He also was not very hopeful of good results from a Committee of Enquiry, which would perhaps be followed by a Royal Commission, but might leave legislation as far off as ever, unless such an inquiry was based on a definite Drafts' Bill to be used as a basis of investigation as in the case of the Fire Brigades' enquiry of 1900. Perhaps the most important of the suggestions mentioned was that relating to retrospective legislation, such as that possessed by Glasgow. Suggestions were put forward by the Fire Prevention Committee with which he was accociated requiring that such retrospective regulations were particularly necessary in the City of London for high buildings. But when the London County Council arrived with its proposed amended Building Act the Corporation, as representing a large number of property holders, was up in arms and disliked that measure. It was not contended that the measure put forward by the London County Council was a model, but surely it was not a legitimate subject for such an outcry in the city as was heard. It was rather a question for careful discussion and amendment than one for almost forced withdrawal. He understood that the County Council, the Corporation, the Boroughs and technical institutions would meet to reconsider that Bill, and he hoped that, as far as London was concerned, the Building Act Amendment Act would be so redrafted as to be really useful, but so as not to meet with such opposition on the part of property owners. The retrospective legislation should not be so drastic as that put forward by the London County Council. It was absolutely necessary to schedule or to classify the buildings according to their risks, and not to put them all alike into one category, whether the building was a bank or a woodworking factory. He agreed with the need for creating a Government Fire Department, which should be a central authority on the question. If such were established, it would be possible to obtain the full statistics on fire which were so necessary. At present the figures as to the causes of fire in Great Britain, and of the losses by fire, were in a most deplorable condition. The case was much better in Russia in that respect. He did not agree with Mr. Phillips's argument regarding the insurance companies paying contributions towards fire extinction. The insurance company for a premium stepped into the shoes of the property holder, and, as far as fire risk was concerned—in its relation to public authority—was nothing but a property holder. The insurance company rated its risk according to the nature of the risk found; and if that risk included a contribution towards fire extinction, that risk must necessarily be increased. Moreover, the author was wrong in his comparisons. The State not only prevented crime, but it also had a police force to catch the criminal, to put him into prison, and prisons to keep him in; the State (using the word in Mr. Phillips's sense) not only looked after the prevention of disease, but it had its general hospitals, fever hospitals, and asylums; thus the State participated in cure as well as in prevention. He held it to be the duty of the State, whether represented by a central or local authority, to safeguard the property of owners against fire as far as possible, just as it should

safeguard life. In regard to the advisability of teaching and training school children how to act in time of fire panic, the speaker had recently discussed the matter with that wonderful expert on matters of public control, M. Lepine, the Prefect of the Paris police, who was in sympathy with the speaker's view of the importance of introducing such teaching into fables, so that children should by that means be taught to dread fire and learn the danger of playing with matches, and the upsetting of lamps, and knowing how to behave on an emergency. In the matter of fire protection, Britons had much to learn from foreign countries, both on the question of legislation and fire-extinguishing appliances, and Mr. Phillips rightly included the study of foreign affairs in his programme.

Mr. S. CHATWOOD said it had been his lot to examine many buildings which were professedly fire-proof, but which had collapsed in the presence of fire because they had been constructed on wrong principles, the pillars of iron and steel being exposed to the direct action of fire, instead of having a casing of comparatively cheap material which provided an air-space between it and the structural material. He referred also to the use of such materials as tungstate of soda and sulphate of alumina. With regard to hoists, the aperture for the hoist became, in time of fire, really a funnel, and provision should be made in buildings for such funnel to be shut off from the fire. That could be done without difficulty, as was the case in an hotel in Düsseldorf at which he stayed last year.

Mr. A. CASSON said he had some experience in making by-laws and regulations bearing upon fire prevention, as he had been concerned as an official of the Local Government Board in framing rules for the approval of that Board, and revising by-laws submitted by local authorities. He had been much struck with the ease with which local authorities made laws restricting the liberty of the individual, especially as contrasted with their unreadiness to provide suitable regulations for property. The explanation he believed was to be found in the fact that the local governing bodies consisted of gentlemen holding a considerable amount of property in the particular district. He thought it was necessary to cultivate public opinion on the subject, and he trusted the author's success would stimulate public opinion on the matter, which would be better than remaining apathetic until a coroner's jury called attention to the subject.

Mr. E. T. SCAMMELL congratulated the Council of the Society on the choice of subject for the prize, and the prize-winner on gaining it. Among the fire-resisting materials referred to by the author was hard wood, such as oak and teak. He had seen the recent tests conducted by the British Fire Prevention Committee, of which Mr. Sachs was the chairman, and it was seen in those tests that the Australian jarrah wood was comparatively non-inflammable. In the fire in the yard of a large timber company, last September, which he saw, the fire raged fiercely until it came to the stacks of the jarrah wood, when the fire seemed to be stayed, the timber being only charred. He thought the discussion was one of the most important on which the Society could enter.

Major FOX (London Salvage Corps) was very pleased to hear the careful compilation of facts in the paper, but thought it had been rather a peg on which to hang the old grievance that fire brigade matters in thi country were in a state of chaos. That was scarcel fair to some of the large towns which had taken very great pains in organising their fire brigades, nor t those localities which relied upon volunteer effort, fo some of them were of a high order of merit. O course, some firemen were worse than useless but it was not fair to tar with the same brush th whole of the organisation of the country. Wit regard to fire insurance companies contributing t the maintenance of fire brigades, Mr. Sachs ha tackled the question in the proper spirit; he woul say no more on that, partly because he served the fir insurance offices, and partly because others in the roor were more competent to speak of it, but he reminde the audience that the question of loss of life at se was entirely in the hands of private effort. He wa not a believer in materials being fireproof, though h agreed to the term fire-resisting. He was present at th fire referred to by Mr. Scammell, and the fact wa that the wood which was consumed was burnt befor the brigade got the full force of water to bear, an that when the check occurred at the spot mentione the water was being directed to it with great forc In the test of supposed fireproof materials at Earl Court, the fire did not get through for a long tim but as the Chairman of the Fire Prevention Com mittee and himself were leaving the grounds the were startled by a tremendous explosion, due to th superheating of the pent-up air. He would not ha liked to have been working on a building under suc conditions.

Mr. SCAMMELL explained that he obtained h information from the Fire Prevention Committee report, which stated that that particular wood ha been attacked fiercely by the fire, but was on charred.

The CHAIRMAN proposed a vote of thanks to M Brice Phillips for his paper, and to Mr. Paul a Mr. Henderson for their abstracts. Those pape would be found to be full of valuable information legal, financial, and political, and they criticis unmercifully many of the rules and regulations a Acts existing. The great problem was how to bri these facts and views before people who were ignora of them, before those whose duty it was to legisla and to carry out the Acts which were passed. I referred to the approaching exhibition at Sou

Kensington, promoted by Mr. Sachs, and the prizes which would be offered for competition. Undoubtedly, teaching children the value of means to put out fires was important, and he gave an illustration in his own family. But there were some people who required to be taught more than did our children—the masters of workshops and businesses, and the legislators of Westminster, and elsewhere. He trusted the papers which had been read that evening, and the conference at South Kensington, would result in the spread of that knowledge which was so desirable.

The vote of thanks was carried unanimously.

Mr. BRICE PHILLIPS, in reply, thanked the Chairman and the audience for their appreciation of his paper. He was still of opinion that fire insurance companies should pay something towards the expenses of fire prevention. He had not said that the local authorities must not carry out that work; they actually did so. It was true that insurance companies placed themselves in the position of property-holders, and that was admitting the argument he had raised; that they were, in effect, the owners, and as owners, they had responsibilities, and that they should meet, at any rate, some part of the expenses of fire prevention.

Correspondence.

ON THE EARLY APPLICATION OF MAGNETO-ELECTRIC MACHINES FOR ELECTRO-METALLURGICAL PURPOSES.

Slater, Heelis, Williamson,
Colley and Tulloch.

71, Princess-street,
Manchester.
10th March, 1903.

Sir H. Trueman Wood,
Secretary of the Society of Arts,
London.

DEAR SIR,

We have been consulted by Dr. Henry Wilde, F.R.S., with reference to an article in the *Journal of the Society of Arts* of January 30th last, "On the Early Application of Magneto-electric Machines for Electro-metallurgical Purposes," and he has instructed us to write to you with regard to it.

In our client's view the article in question bears internal evidence of having been written by one who possesses much more knowledge of the subject than he has thought fit to communicate to his readers. The statements contained in the article are so far contrary to fact that, notwithstanding Dr. Wilde's unfortunate difference with the Council of your Society in the matter of the Award of the Albert Medal, we feel confident that he has only to place before you the true facts of the case to ensure your taking steps to rectify mis-statements which are calculated to injure his reputation as the inventor of the separately excited dynamo-electric machine, and as the first to apply it to the electro-deposition of metals from their solutions.

Dr. Wilde instructs us that notwithstanding the promise held out by Woolrich and others, in the substitution of magneto-electric machines for voltaic batteries in the electro-deposition of metals, such machines soon fell into disuse, and the only one in actual operation, either in this country or abroad, at the time of the advent of Dr. Wilde's dynamos, 1866-1867, was at the works of Messrs. Elkington and Co., of Birmingham, where it was used to generate but a fraction of the power required for their productions, the greater part of their electro-depositing being carried on by means of voltaic batteries. This surviving magneto-machine was superseded by Dr. Wilde's dynamos in 1869.

The further statement in the *Journal* with regard to the patent of Millward is misleading, and conveys to the reader the impression that Millward patented a machine for electro-metallurgical purposes, in which electro-magnets were separately excited by currents from a magneto-electric machine, an impression which is entirely contrary to the fact.

W. Millward's patent, No. 13536, 1851 (the specification of which we have seen) consisted of two improved forms of magneto-electric machines with permanent magnets, the currents from which the inventor states, are to be used to excite an electro-magnet, for the purpose of magnetising permanent magnets of steel or cast iron.

No suggestion whatever is made in Millward's specification of the generation of electric currents from the electro-magnet so excited, nor is the application of his improved magneto-electric machines to electro-metallurgical purposes so much as mentioned.

You will perceive that the writer of the article in question, without mentioning our client's name, in effect alleges that his invention of the separately excited dynamo was anticipated by Millward's patent. When we say that W. Millward himself was one of our client's earlier licensees, under an agreement which the predecessors of our firm prepared, for the application of our client's machines, to electro-metallurgical purposes, and that Millward made a substantial annual payment, in the form of Royalty, for a period of fourteen years, notwithstanding that he might have terminated the license so granted at the end of any one year, you will see how inaccurate the article in the *Journal* is.

Dr. Wilde tells us further, that during the whole period of his business relations with W. Millward, the latter never referred to his patent of 1851, for electro-magnetic apparatus, although he had frequent opportunities of so doing.

W. Millward's name, as also that of his brother Arthur Millward of Sheffield, will be found in the list of Dr. Wilde's licenses sent to you on the 18th June, 1900, at the time when the terms of the award to him of the Albert Medal of the Society of Arts were under discussion.

Dr. Wilde instructs us to say that he trusts that a consideration of the inaccuracies to which we have drawn your attention above in the matter of the history of the dynamo-electric machine may lead to a better understanding between himself and the Society, for which, notwithstanding his past differences with its former Council, he has always entertained, and still entertains, the highest regard.

You will no doubt now wish to take steps to rectify, so far as may be possible, the mischief caused by the article to which our client complains. As indicating in some degree the manner in which the mischief spreads, we may say that the article was reprinted in the *Electrical Review* of the 20th ulto.

We shall be glad to hear from you at your early convenience.

Yours truly,

SLATER, HEELIS, WILLIAMSON & CO.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock:—

MARCH 18.—"New Aspects of Life Assurance." By WILLIAM SCHOOLING. THOMAS EMLEY YOUNG, B.A., will preside.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock.

MARCH 17. 4.30 p.m.—"Artistic Fans." By MISS HANNAH FALCKE. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

PROF. J. A. FLEMING, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." Four Lectures.

LECTURE III.—MARCH 16.—*Receiving Arrangements and Receivers.*—The function of the receiving aerial — Electric wave detectors or responders — Classification of responders—Hughes's metallic microphone—Branly-Lodge coherer—Marconi receiver—Anticoherers—Magnetic receivers—Marconi's magnetic receiver—Thermal and electrolytic responders—Various forms of receiving arrangement.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 16...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. J. A. Fleming, "Hertzian Wave Telegraphy in Theory and Practice." (Lecture III.)

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. H. Droop Richmond, "The Standardisation of Analytical Methods." 2. Mr. Arthur R. Ling, "The Standardisation of Commercial Methods of Analysis, especially those applied to Brewing Materials."

British Architects, 9, Conduit-street, W., 8 p.m. Mr. Charles Hadfield, "Westminster Cathedral."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. E. W. Masterman and General Sir C. W. Wilson, "The New Water Supply of Jerusalem."

TUESDAY, MARCH 17...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Applied Art Section.) Miss Hannah Falcke, "Artistic Fans."

Royal Institution, Albemarle-street, W., 5 p.m. Sir Robert Ball, "Great Problems in Astronomy." (Lecture I.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. Sidney Preston's paper, "Recent Irrigation in the Punjab." 2. Mr. John J. B. Benson, "The Irrigation Wier across the Bhadar River, Kathiawar." 3. Mr. Amyas Morse, "The Protection Works of the Kaiser-i-Hind Bridge over the River Sutlej near Ferozepur."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. Bolton King, "Statistics of Italy."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. J. T. Cunningham, "Observations and Experiments on Japanese Long-tailed Fowls." Other papers by Sir Charles Eliot and Mr. W. P. Pycraft.

WEDNESDAY, MARCH 18...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. William Schooling, "New Aspects of Life Assurance."

Meteorological, 25, Great George-street, S.W., 7½ p.m. Mr. C. V. Boys, "The Passage of Sound through the Atmosphere."

Chemical, Burlington-house, W., 5½ p.m. Papers by Mr. A. C. Chapman, Messrs. A. W. Crossley and P. Hass, Messrs. J. J. Dobbie, A. Laudie, and C. K. Tinkler, and Messrs. P. C. Ray and J. N. Seh.

Microscopical, 20, Hanover-square, W., 8 p.m. Mr. J. W. Gordon, "The Helmholtz Theory of the Microscope."

Entomological, 11, Chandos-street, W., 8 p.m. Papers by Mr. George C. Champion, Dr. Frederick A. Dixey, and Mr. Edward Saunders.

Royal Archæological Inst., 20, Hanover-sq., W., 4 p.m.

THURSDAY, MARCH 19...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. G. Claridge Druce, "*Poa laxa* and *Poa stricta* of our British Floras." 2. Messrs. John Parkin and H. H. W. Pearson, "The Botany of the Ceylon Patanas. Part II. Anatomy of the Leaves."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. C. H. Firth, "Society during the Commonwealth and Protectorate." (Lecture I.)

Historical, Clifford's Inn Hall, Fleet-st., E.C., 5 p.m. Mr. R. J. Whitwell, "Italian Bankers and the English Crown down to the failure of the *Societas Ricardorum* of Lucca."

Numismatic, 22, Albemarle-street, W., 7 p.m.

Mining and Metallurgy, Geological Society's Rooms, Burlington-house, W., 8 p.m. Annual Meeting. Presidential Address.

FRIDAY, MARCH 20...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. L. A. Schäfer, "The Paths of Volition."

North-East Coast Institute of Engineers and Shipbuilders, South Shields, 7½ p.m.

Art Workers' Guild, Cliffords Inn Hall, Fleet-street, E.C., 8 p.m. Lecture on "Modern Arts and Crafts Movements in Holland."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Mr. James Rowan, "A Premium System Applied to Engineering Workshops."

SATURDAY, MARCH 21...Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "Light: its Origin and Nature." (Lecture IV.)

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FRIDAY, MARCH 20, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, March 23, 8 p.m. (Cantor Lectures.) Professor J. A. Fleming, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." (Lecture IV.)

Wednesday, March 25, 8 p.m. (Ordinary Meeting.) Arthur Kitson, "Oil Light by Incandescence."

Further details of the Society's meetings will be found at the end of this number.

COLLECTION OF FANS.

A collection of fans brought together in illustration of a paper on "Artistic Fans," read by Miss Hannah Falcke, before the Applied Art Section, on Tuesday afternoon, March 17, is now on view in the Library.

Antique Fans have been kindly lent for this occasion by the Board of Education, the Marchioness of Bristol, Mrs. Bischoffsheim, Mrs. Cantlie, Mr. S. Chick, Mrs. Oakley Coles, Miss Colston, Miss Falcke, Mrs. Oldroyd, Miss Oldroyd, Mr. R. G. Pugh, Mrs. Rodwell, and Miss Webster. Also Modern Fans by Mr. S. Chick, Messrs. Debenham and Freebody, Mr. John Leighton, Messrs. Liberty and Co., Madame Marcot, and Messrs. Marshall and Snelgrove.

The Exhibition will be open daily until the 25th inst., from 10 till 5 o'clock. On Monday, 23rd, and Wednesday, 25th inst., the Exhibition will also be open from 7 till 10 p.m.

Members can admit their friends by the use of the usual tickets supplied to members. There will be no restriction as to the number of tickets issued.

VIVA VOCE EXAMINATIONS IN MODERN LANGUAGES.

These Examinations are now held in French, German, and Spanish.

Certificates (of one grade only) are issued on the result of the Examinations.

The Examination will include Dictation, Reading, and Conversation. Candidates will be expected to satisfy the Examiner in all these branches.

They can be held at any date, at any of the Society's Examination Centres, where the Local Committee will undertake to make the necessary arrangements, and to pay a fee of 2s. 6d. per Candidate, for not less than 24 Candidates in each subject.

The Local Committee will be expected to pay the Examiner's travelling expenses.

The Committee may charge an additional fee to cover local charges. It is suggested that this fee should be kept as low as possible.

The Examinations in each Language are entirely separate and distinct.

Secretaries of Committees desiring to hold any of these Examinations, should inform the Secretary of the Society of Arts of the date on which it is proposed to hold it. He will then endeavour to arrange a date which may suit the convenience of the Committee and of the Examiner.

Further information can be obtained on application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

CANTOR LECTURES.

Professor Fleming, F.R.S., delivered the third lecture of his course on "Hertzian Wave Telegraphy in Theory and Practice," on Monday evening, 16th inst.

The Lectures will be printed in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday afternoon, March 17th, 1903, Sir George Birdwood, K.C.I.E., C.S.I., Vice-President of the Society, in the chair.

The paper read was on "Artistic Fans," by Miss Hannah Falcke.

The paper and report of the discussion will be published in the number of the *Journal* for April 10.

Proceedings of the Society.

COLONIAL SECTION.

Tuesday afternoon, March 3, 1903; Sir Harry H. Johnston, G.C.M.G., K.C.B., in the chair.

The paper read was—

THE UGANDA OF TO-DAY.

By Herbert Samuel, M.P.

The Protectorate of Uganda lies near the centre of that vast portion of the continent of Africa which was left a blank, and described as unexplored, in the maps of only fifty years ago. The nature of the territory was a matter of speculation. The character of its interesting peoples was wholly unknown. Of the very existence, indeed, of the kingdom of Uganda not a whisper had reached the ears of the European nations. Almost in a moment, as historical time is reckoned, Uganda has been drawn out of the darkness of ages and brought into the full sunlight of the civilised world. The change has been dramatic. To-day the traveller may reach these regions, by rail and by steamer, in less than four weeks' travelling from London. He will find there all the machinery of a highly-organised government. He will visit great churches with devout congregations of thousands of Christian worshippers. He will find schools and hospitals. Day by day he will read the chief news of the world conveyed by the telegraph. He may buy in the shops of the towns almost any ordinary commodity of Western manufacture. He will visit the native chiefs and find them living in two-storied houses of brick, built in European style, their rooms decorated with familiar prints from London illustrated papers. He may be entertained by one of these chiefs, as I was entertained, at a dinner cooked and served in a manner not unworthy of an English table. He may go among the people alone and unarmed, and everywhere meet with a ready welcome and invariable respect.

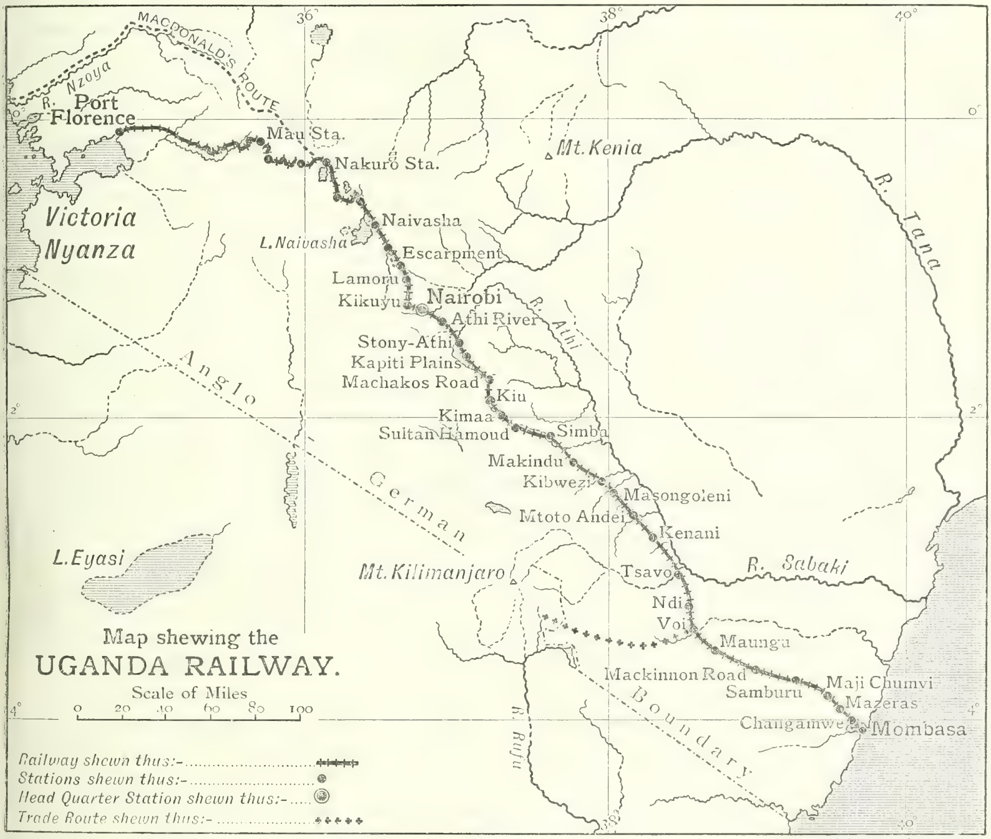
This remarkable development—more remarkable and more rapid, I believe, than the history of any other country can show—has been the result of a double revolution: first, the advent of the English explorers—Speke and Grant in 1862, Stanley in 1875; followed by the missionaries in 1877, and by the annexation of the country to the British Empire in 1894: second, the building of the Uganda Railway, which has shortened the journey from the coast at Mombasa to the capital of Uganda to five days instead of three months, and has cheapened the cost of the carriage of goods in proportion.

The inhabitants of the Uganda Protectorate belong to a variety of tribes with differing characteristics. The most important, the most intelligent, and the most interesting of these are the Baganda, themselves the inhabitants of what is styled the Uganda Province of the Protectorate, roughly conterminous with the ancient kingdom of Uganda. They number about one-fourth of the total population of the Protectorate, which has been estimated by Sir Harry Johnston at four millions. Among these tribes it is with the Baganda alone that I shall deal in this paper.

They are a race of well-formed, pleasant-featured men and women; quick-witted, compared with other Africans; eager to welcome novelties; tactful and courteous; but not overmoral. The richer among them are dressed in robes of white cotton-cloth for the men, in brightly-coloured draperies for the women; the poorer wear dresses of the bark-cloth peculiar to the country, made from long strips of the bark of a species of fig-tree. Orange-red in colour, the bark-cloth dresses harmonise well with the bronze-black skins of the wearers. The huts of the peasants are simple structures of bee-hive shape, built of branches, covered with a thatch of dried grass. The staple food of the people is the banana.

When the first white men entered the country, they found an elaborate system of political, social, and legal institutions. A monarchy, which had been vested in a single dynasty for several centuries, stood at the summit of a complete scheme of feudalism. The king, the great chiefs, the lesser chiefs, and the peasantry, formed a hierarchy based partly on land tenure, partly on *status*. The crown had its royal demesne, from which a large part of its revenues was drawn. The greater chiefs did homage for their lands and were bound to follow the king in war; the lesser chiefs being similarly bound to them, and the peasantry to the lesser chiefs. There was in vogue the custom of "scutage"—those who did not render military service paying a composition to their feudal superior. By the law of escheat, lands would sometimes revert to the

crown. The offices of state were some of them hereditary, some granted by the king's favour. A *Magnum Concilium* of the leading men met as the advisers of the sovereign. At the bottom, the social system rested, not on slavery, but on serfdom; the peasantry being *ascripti glebæ*, bound to the soil, and passing from lord to lord with the transfer of the estates. The feudal customs of mediæval Europe had, indeed, exact and remarkable counterparts in this isolated country in the heart of Africa. The explorers found also fleets of large canoes, that formed an effective navy on the Victoria Nyanza. They found that many of the natives were clever craftsmen, making elaborate musical instruments, pottery and basket-work of fine manufacture and often of tasteful decoration, mats and cloaks of beautifully tanned skins, shields of peculiar and skilful design.



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The superiority of the Baganda over all the surrounding peoples has almost certainly been due to the intermixture long ago of a race called the Bahima, Hamitic in origin and features, allied to the Abyssinians and Gallas. Coming from the north-east, they brought with them many of the elements of civilisation which, among pure negroes, are unknown. By intermarriage they founded, or influenced, the leading families of the Baganda, and their presence in this part of Africa accounts for the distinctive customs which belong to this people, and, to less degree, to some of the neighbouring tribes.

Such were the inhabitants of Uganda when the white men came among them. The first to exercise a permanent influence were the missionaries. In spite of intermittent persecutions, the work of the missions has steadily grown; they now pervade the country; they are welcomed with cordiality, and are followed with enthusiasm. The Church Missionary Society alone has 81 of its members at work in the Protectorate. They have taught to read, have instructed in the principles of Christianity, and have afterwards baptised, over 30,000 of the natives, and of these they have trained between two and three thousand for the work of auxiliary

teachers and preachers. Seven hundred churches are scattered through the Protectorate, and 5,000 natives are baptised every year. The Roman Catholic missions also have a large following. Of the chiefs, all have now abandoned the Nature and Spirit worship which was, in earlier days, the national creed; a few have embraced Mohammedanism; but the great majority are Christians, and two or three of the most important are ordained ministers of the Anglican Church.

At Mengo, the native capital, the Church Missionary Society has built a great cathedral church, over two hundred feet long, to seat between three and four thousand people. At the time of my visit, a year ago, it was nearing completion and should now be ready for inauguration.

Of the many impressive sights that the traveller may see in Uganda, to my mind there is none more impressive than to watch the congregation at one of the Sunday services, which at that time were being held in the large schoolrooms. Imagine a long hall with white-washed walls, unglazed openings for windows, a floor of beaten earth, a thatch roof supported by rows of palm trunks. Imagine all down the hall many hundreds of negro men and women sitting on antelope or goat-skin mats spread on the floor; the men occupying one side of the room, all of them clothed in long gowns of spotless white, a few with European coats of linen or cloth as well; the women occupying the other side—some clothed in coloured draperies, but most of them wearing the orange-red bark-cloth dresses; here and there, seated on chairs, a few English of both sexes, the missionaries and teachers. Imagine the service conducted by a native, well-known as a chief controlling a vast district. Picture to yourselves the whole congregation sitting throughout the service in absolute decorum, following in their prayer-books all that is said, reading the responses, joining in a quiet and solemn "Amina" at the end of each prayer, rising in groups of six or eight to receive the Communion from the hands of the surpliced minister; outside, the hot sunlight, and a complete silence, broken only by the chirping of the grasshoppers—and then you will realise, not unfaithfully, a typical Sunday service at the mission headquarters in Uganda.

In these schoolrooms every week-day, between eight hundred and a thousand boys and girls come to be taught—a number that would be far exceeded if the strength of the teaching staff and the accommodation allowed. As it is, much of the instruction is given by pupils who have passed through the school since its opening, five years ago. A proportion of the pupils are learning English; all learn reading, writing, arithmetic, Bible history, and the principles of the Christian faith. Arithmetic is apparently the subject specially congenial to the Uganda mind. Invited by the head-master to set a sum for the highest class, and specially asked to make it difficult, I wrote the following on the black-board. (It should be remembered that the Indian currency has been introduced by the British Government to supplement, and, ultimately, to supersede the native currency of cowrie shells.) "A man has 527 sheep and 28 cows; he sells 126 sheep for Rs. 3 a. 4 each; the rest of the sheep for Rs. 4 a. 2 each; the cows for Rs. 32½ each. If there are 926 shells to a rupee, how many shells will he receive?" Not only the first class, but several boys in the second class, were set to do this sum; they were given no help; and they all, with one exception, returned the correct answer. The incident, though trivial in itself, will give some evidence how far removed are the Baganda in mental capacity from that low level of brutalised stupidity which, in the opinion of some Englishmen, is the natural mark of the negro races.

Near the schools was a roomy hospital, with eighty beds, which was unfortunately struck by lightning a few weeks ago and burnt to the ground. A new and much larger hospital is to be built, for which the chiefs have promised to supply gratuitously all the timber that is needed, and the people all the labour.

However modest may have been the success that has attended missions in some other parts of Africa, there is no Englishman in Uganda but is ready to bear testimony to the admirable service which they are rendering there. They are gradually raising the whole standard of morality of the people, and in the regeneration of the country which is now proceeding, their influence plays a foremost and an honourable part.

Thirteen years after the first missionary, came the first British administrator, Captain Lugard, now General Sir Frederick Lugard, who entered Uganda as the agent of the British East Africa Company at the end of 1890. Financial difficulties having brought the company to a premature end, the country was annexed to the British Crown in 1894, and taken under the direct control of the Foreign Office.

The system of government which has since

been established, and which has been placed upon its present footing by the statesmanship of our chairman of to-day, Sir Harry Johnston, has endeavoured, and successfully endeavoured, to superimpose on the native administration a British control sufficient to ensure an enlightened and progressive rule, without destroying what was good in the native institutions, or depriving the people of the country of their proper part in the management of public affairs. There is a Chief Commissioner of the Protectorate, under whose direction are a small number of British officials at Entebbe, the English capital, and in the chief centres of the country. But the native monarchy remains. The old offices of State continue in the hands of the chiefs. Each district is still administered by a native nominated by the king, although his appointment is subject to confirmation by the Chief Commissioner, and his acts in matters of importance to the veto of the British administrator of the district. The present king being a minor—a boy of six years old—a regency of three members acts on his behalf, and the regents are all natives. The Lukiko, or council of the chiefs, still meets in the palace on one day each week, with the little king, seated on his throne, formally presiding; and it still discusses and decides upon public questions unhampered by the presence of any English official. Justice is administered in native cases, and the taxes, which are fixed in amount, are collected, not by the English; but by the native administrators. The system apparently works with perfect smoothness. More than once leading chiefs volunteered, in conversation with me, expressions of their full satisfaction with the present *régime*, and of their sincere desire to co-operate loyally with the British administrators.

The one complaint that is made relates to a matter that has not been under the control of the local authorities, but for which the Foreign Office at home has been responsible. It is the frequency with which the Chief Commissionership, and Acting Chief Commissionership, have passed from hand to hand. Since the Protectorate was established nine years ago, there have been no fewer than seven changes in the supreme authority. Personality counts for much in the government of the black races, and however competent the seven gentlemen may have been who have successively represented the British Crown in Uganda, it does not conduce to successful administration for Commissioners constantly to send in their resignations, or to be transferred to other posts, when they barely have had time to become known to the people under their control and to make themselves acquainted with the many and complex questions with which they have to deal. There is consequently a general desire that the present Commissioner, Colonel Sadler, may retain for at least some years the office which he so ably fills.

Partly to the influence of the missionaries and of the administrators, but partly also to the construction of the new railway, is due the revolutionary transformation which makes the Uganda of to-day so different from the Uganda of the past. This line is a Uganda railway in name, but in name only. It does not enter, and it is not designed to enter, the Uganda Protectorate. Its entire length lies within the boundaries of the Protectorate of British East Africa. Starting from the fine harbour of Mombasa, on the East African coast, it runs in a west-north-westerly direction for 580 miles until it reaches the shore of the Victoria Nyanza at a spot in the neighbourhood of Kisumu, which now bears the name of Port Florence. From this place it is a two-days' voyage across the lake to Entebbe in the centre of the Uganda shore.

The railway was open for through traffic from the coast to the lake last March; the trains were then running for considerable distances on temporary lines, but the permanent way is now practically complete. Two steamers of 600 tons have been built to gather for the railway the merchandise of the fertile countries that lie around the shores of the great lake, 1,000 miles in extent; one of these steamers made its first trip two weeks ago, and the other will be launched very shortly. Half-way up the railway, a town—Nairobi—has been constructed as the headquarters of the railway service and one of the centres of administration of the British East Africa Protectorate; and here, far in the interior, have been erected efficient railway workshops, in which six hundred artisans are continually employed, and in which everything needed for the line, except rails and wheels, can be manufactured.

That the policy of building the railway was a wise one, I, for one, can entertain no doubt. That the cost of its construction has been excessive, appears to me to be equally certain. Estimated to cost under two millions, Parliament has been called upon to vote nearly six millions to complete the undertaking. It is true that there have been many difficulties which were unforeseen by the framers of

the original estimate; engineering difficulties, difficulties in obtaining labour, difficulties in the supply of water, and an increase in the cost of coal. But the fact remains, when full allowance has been made for these, that the claims of economy have been regarded somewhat lightly by the Foreign Office Committee and by the engineers who have been charged with the construction of this line. I state this not as an opinion founded on my own observation. A traveller who has merely passed over the railway, and who is not an engineer by profession, is in no way qualified to form a judgment on such a point. But I was fortunate in having opportunities for discussing the question with a number of Europeans in East Africa and Uganda—administrators, traders, missionaries, doctors, assistant engineers; and the universal opinion of those on the spot is that there has been frequent extravagance in the methods of construction, that unnecessary works have been undertaken, that many mistakes have been made, that there has been much laxity of financial control in matters of detail. From none of those whose views I ascertained did I hear a contrary opinion. But no one who is acquainted with the circumstances can in fairness fail to bear testimony that, open as are the constructors of the railway to criticism on this ground, they are nevertheless entitled to no small measure of gratitude from the country for the successful completion of this great national undertaking, carried out in a country previously almost unexplored, and accomplished in defiance of many formidable obstacles.

It is difficult to over-estimate the probable effects on the development both of Uganda and of British East Africa that will ensue from the building of this line. For the first time it will be possible to open up trade with the interior. The carriage of goods from Uganda to the coast previously cost about £200 a ton, a rate that was necessarily prohibitive for all articles except ivory. The cost for most commodities is now about £4 a ton. Almost any tropical product can be grown with success in the region of the Victoria Nyanza, and although the world's supply of tropical products has vastly expanded in recent years, there will doubtless prove to be many branches of trade—india-rubber may be specially mentioned—in which East-Central Africa will be able to excel. In exchange, there will certainly grow, as civilisation spreads, a demand for many kinds of European articles, especially among the Baganda, always eager for novelties. All this, however, is necessarily in the future. In the whole of the vast Protectorate of Uganda there was only one firm of European planters a year ago, and they were working on a small scale, and had not been established long enough to make, or to expect, any considerable profit. Such small beginnings of trade with the natives as then existed were almost wholly in the hands of Indians and of Germans.

For colonisation by European settlers, Uganda, except the mountainous districts of Ruwenzori and Elgon, is unsuited. Although the country is from three to four thousand feet above the sea, and although the climate is not so hot as to be injurious to health, the territories lie on the equator, and the climate is too hot to allow Europeans to work with comfort, or to desire to make Uganda a permanent home. Moreover, there is more malaria than is usually supposed, and no small percentage of the white population will be found, at any moment, to be suffering from attacks, mild or serious, of this trying disease. In the East Africa Protectorate, on the other hand, there is a great tract of country lying around and to the west of Nairobi, and from 5,000 to 8,000 feet in elevation, which is perfectly healthy for Europeans and eminently suited for colonisation by pastoral and agricultural settlers. The territories through which the railway passes are now for the most part almost deserted. The line is at present, in the words of Sir Charles Eliot, the Chief Commissioner of the East Africa Protectorate, only a backbone without a body. But as the advantages of these highland districts become known, there is every reason to hope that colonists will take up the land, and that the railway will prove the means of creating in the heart of East Africa another white colony of the Empire.

It is unnecessary to dwell on the facilities given to the work of administration in Uganda by the building of this line. Seriously hampered in a time of crisis—such as the mutiny of the Soudanese soldiers in 1897 and 1898—by the difficulty of securing reinforcements of troops; costly in its operations through the heavy expense of the transport of stores; its officers exposed to frequent hardships and continuous discomfort by their isolation—the administration of Uganda in earlier days could hardly be expected to be wholly satisfactory. All this has been changed. The improvement in the means of communication with the sea has

made it possible to secure in Uganda a system of government as firmly established, as efficient, as attractive, and at least as economical, as that which is the pride of the Empire in our Indian dependency.

To the tourist, also, the railway has opened fresh and interesting fields. At a cost, and in a time, hardly greater than are needed for a journey to Ceylon or to South America, he may spend an instructive holiday in the heart of the Dark Continent. Safe in a railway-carriage, he may watch a zoological garden at large—antelope by the thousand, zebra by the hundred, ostriches by the score, jackals and hyænas, and, if he is fortunate, elephants and giraffes, rhinoceros, leopards, and lions. He may visit on his way the kraals of the primeval savage, of the Masai, the Wa-Kikuyu, or the Wa-Kavirondo. He may mix with the intelligent and courteous chiefs of Uganda itself. Perhaps, indeed, the time is not distant when the tourist agencies will be issuing return tickets from London to the source of the Nile, with extra coupons for a circular tour to the lands of the forest pygmies.

It may be, again, that the railway will open fresh recruiting grounds for the supply of the labour of which the mines of the Transvaal are at present in need. But the desirability and the success of such an enterprise must needs depend, first, on the character of the persons who are allowed to carry on the recruiting operations; secondly, on the suitability of the conditions under which the labourers are transported, housed, employed, and enabled to return to their homes; and thirdly, so far as the Baganda are concerned, on the possibility of supplying them at Johannesburg with the plantain diet without which, it is said, they cannot live in health. A deputation from South Africa, sent with the object of enlisting labourers, arrived in Uganda at the end of last year. Although they promised high wages, the prospects were not sufficiently attractive to the people, and the emissaries returned without having obtained a single man. Further attempts under other auspices, conducted by agents in whom the natives have confidence, and ensuring conditions which, from a humanitarian standpoint, are wholly free from objection, might possibly meet with better success.

A survey, however brief, of the present condition of Uganda, would be incomplete indeed, if it made no special mention of the part played by the Indian in its development. It is the Indian, under the direction of the Englishman, who has been the civiliser of East Africa. It is the coolie who has made the railway; the Indian artisan who fills the railway workshops; the Sikh who forms the backbone of the military forces, and, in British East Africa, of the police; the Bengali and the Goanese who staff the railway station offices, the post offices, and the subordinate posts in the Government departments; the Parsee and the Goanese who conduct the greater part of the retail trade. If the Indian is not highly efficient, his services at least suffice, and, above all, are cheap. The progress of these portions of Africa would have been slow indeed, had it not been possible to draw upon our Asiatic possessions for unlimited supplies of subordinate labour with brain and hand. In some places there is, it is true, a certain hostility on the part of the small unofficial population of whites to this invasion of Asiatics, a certain jealousy of their competition. But the services that they have rendered have been so invaluable, their presence is so indispensable, that I cannot conceive that the governing authorities will consent to check their activity. It is rather probable, on the other hand, that steps will be taken, in districts unsuited for European settlement and now thinly populated by Africans, to introduce colonies of Indian peasants, whose laborious industry could hardly fail to increase the prosperity of the country and to add one more to the many services for which Africa is indebted to their nation.

That the people of Uganda have gained largely by the establishment among them of British rule admits of no question. The country enjoys a tranquility which it never knew before. The peasantry are protected from the cruelties of despotic chiefs, and the chiefs from the tyranny of a despotic king. There are no longer execution-grounds reeking with the blood of the victims of royal caprice. The people pursue their industries in security, and travel at their will from place to place unharmed; and the approach of a caravan no longer brings the old terror of slave traders' raids, which Speke so graphically described. Churches and schools are raising the moral and intellectual tone of the nation. And here, at least, contact with the European has not brought debasement, as in some other parts of Africa, by the importation of fiery alcoholic liquors, for none are allowed to be brought to the country for sale to the natives; and here the cruelty of the white colonist to the aborigines, which has so often disgraced the relations between the superior races and

the lower, is a thing unknown. If only the Sleeping Sickness, that scourge which never spares a man whom it has once touched, and which during the last three years has carried off many thousands of a people too small in numbers already, can be stayed through the efforts of the medical commission which is now at work, the condition of Uganda will be a source of unchequered pride to the British people which has assumed its guardianship.

The building of the railway and the cost of administration, which at present considerably exceeds the local revenue, entail, and will entail for some years to come, an annual charge on the Imperial Exchequer. But there has been no part of the British Empire which has not in time become self-supporting, and has not returned by the development of commerce the cost of its foundation. "A plantation," said Bacon, using the word in its earlier sense of a colony, "a plantation is like the planting of woods, for you must make a count to lose almost twenty years' profit and expect your recompense at the end." Unless valuable minerals are discovered, it may be that so long a period as twenty years will elapse before this territory can cease to lean on the strong, but sometimes resentful arm of the British taxpayer. Yet in defence it can be urged that of all the items in our national expenditure, there are few indeed which yield a larger return in human well-being than the annual grant-in-aid to the Uganda administration. The Uganda of to-day, under the ægis of England, is a far happier, more enlightened, and more prosperous country than the Uganda of yesterday, and there is no reason to doubt that the Uganda of to-morrow will be better still.

[The paper was illustrated by a number of lantern slides made from photographs taken by Mr. Samuel.]

DISCUSSION.

The CHAIRMAN said:—I for one, and I am sure all the rest of the audience, have listened with the greatest interest to Mr. Samuel's admirable paper, and it will presently be my pleasant duty to move a vote of thanks. We have, however, here to-night several distinguished persons connected with the past and present of these East African territories. Before I call on these gentlemen to add their comments to Mr. Samuel's discourse I should, however, like to say a few words myself. The main interest of what Mr. Samuel has said to us this afternoon has lain for me in his constant references to the way in which Uganda is being developed mainly in the interests of the people of Uganda. I feel deep sympathy for the British taxpayer of these two islands of Great Britain and Ireland, who alone supports the burden of empire, for up to the present time it has been the British taxpayer who has met all the cost of maintaining law and order in the African Protectorates. I am most anxious that this drain on our pockets should gradually come to an end. I am also most anxious that over and above the cessation of loss to us we should eventually recover the money we have invested in these directions by a great increase in our trade with all these parts of tropical Africa, to which we have brought peace after endless years of civil war and rapine. But this reasonable view, I am glad to know, is also shared by, at any rate, the people of Uganda, who met me quite half way in the negotiations I undertook for the establishment of native taxation. One result of my special commission to Uganda was to lay on a firm and just basis the taxation on the natives of that country for the support of the British Protectorate. The taxes agreed to were such as the native can pay with no great difficulty, from the fact that at the outside they are limited to 8s. a year for each able-bodied man. Provided the native here, as elsewhere, contributes according to his means to the upkeep of his own Government, I do think that we should have a very tender care for his interests, present and future, and that we should make all proper provision that the land of these countries in any considerable proportion, should not pass from out of the hands of the native into those of Europeans. Of all the work accomplished by my special commission, I look back with more satisfaction to the results of the land settlement than to anything else. I know that nothing done in recent years has more contributed to the popularity of the British Protectorate than the agreement entered into with the Baganda, by which a reasonable proportion of the soil of the country is assured to the people who live on the soil. I am not yet an old man, or even much advanced into middle age, yet I have seen in my time a very remarkable change of view in my fellow-countrymen as regards the British Empire. I can easily remember the time when we looked upon all extensions of British influence abroad in the light of new British colonies, that is to say, further additions of territory which the white man might occupy (regardless of the people of the soil), and make into a fresh home and breeding-ground for white men. First of all, however, we began to realise that India, though it was a glory to our rule, and a source of profit to our commerce, was not a land destined for the European, but one which must be governed first and foremost in the interest of the Indian and for the benefit and welfare of the Indian. It has also begun to dawn on us that the greater part of tropical Africa will never be suited for a white man's country, inasmuch as—apart from climatic reasons—it is inhabited to a considerable extent by sturdy black men. So at last we are coming to the understanding of what our Empire

means. It means the creation of new white nations—daughter nations, like Australia, New Zealand, South Africa, and Canada—where the white race will be the exclusive or dominant sons of the soil, nations which are rapidly passing from our tutelage into a position of self-government. But the Empire also means the education of backward and alien races, of the yellow man and the black man. It means India, and it means a black Central Africa, a West Indies of mixed nationalities, a Further East of educated Chinese, Malays, Papuans, and Polynesians. I hope that in the prosecution of these aims our commerce will profit so greatly as to bring us substantial monetary reward ; but what we must look for most is the ultimate verdict of history, which should bestow on us an even more splendid crown of remembrance than we are now placing round the brows of the Roman. I am tired of the unmeaning colours of our national flag—the red, white, and blue, which, as you most of you know, in their origin go back to colours attributed to very mythical and not particularly useful saints. The colours of the British Empire, in my opinion, should be white, yellow, and black, with a touch of the British red. I am glad to see present here this evening one of the most distinguished men of his day, Sir Henry Stanley, who 28 years ago completed the work of Speke and forwarded to England the call of Uganda for missionaries. It is wonderful to think of what has occurred in the 28 years which have elapsed between Sir Henry Stanley's stay in the kingdom of Uganda, and the present stage of a Protectorate which, barring the, I hope, temporary affliction of the sleeping sickness, is one of the most prosperous and happy countries under the British Crown. It would be most interesting if Sir Henry Stanley can favour us with some remarks on the subject of Mr. Samuel's paper.

Sir Henry M. Stanley, G.C.B., said :—I think there is nothing but great praise to be given to Mr. Samuel for his very valuable and interesting address. Its style was excellent and literary, the subjects many and varied, and, what I admire above all, it was exceedingly sympathetic. I might also refer to the pictures of natives and African scenes unrolled before us, and I am sure you will admit that they were well selected and so well represented native appearance and life that nothing better could be wished to illustrate the subject-matter of the paper. Mr. Samuel has been good enough to give credit to almost all those who contributed to bring about the state of things which he described as to-day existing in Uganda. He has mentioned the great work done by the missionaries, the explorers who made the country known were not neglected, and of the various administrators he contrived to say what was most appreciative. Naturally, in a brief address which touched upon so many subjects, he could not have named every deserving individual; but as among the greatest of those who gave their money or services to bring Uganda within the Empire, I think it was an omission not to say something about the services rendered by Sir William Mackinnon. A mere glance at what Sir William did in East Africa long before the movement for the inclusion of that country within the British sphere of influence, will prove the motive spirit had actuated him when he formed the Imperial British East Africa Company. During the seventies, Sir William was engaged with Sir Fowell Buxton in making a road from Dar Salaam into the interior with a view of encouraging legitimate commerce as against the slave trade. He won the respect of the Sultan of Zanzibar and his principal men by his benevolence and integrity, and out of their great esteem for him they pressed on him as early as 1878 the taking over of the whole of the mainland for their mutual benefit. At home, however, the authorities shunned the responsibility of establishing British protection over such a large part of East Africa. Later, however, as you all know, the Imperial British East Africa Company was formed, of which Sir William was chairman. It was through his officers, men, means, and energy that the Protectorate was extended to Uganda. But a private company could not hope to compete with the German Empire, and when he asked for the assistance of the British Government it was refused to him. I remember being in Sir William's rooms when Lord Rosebery applied by letter to him, requesting to know what sum he would need to carry on the Government for five years. Sir William answered £50,000 a year. Within a short time the Foreign Office messenger, with Lord Rosebery's note, came back, which said that such a sum was "preposterous and impossible." That modest sum of £50,000 a year which Sir William needed, has now increased to five times that amount. Nevertheless, we have profited by his efforts and private means, and it is but just, that a philanthropist who spent his later years and his money so freely in behalf of his countrymen, should be mentioned when we review the marvellous advance of the country which he started on its career of progress. No better tale of progress could be given than what has been said by Mr. Samuel. "This remarkable development, more remarkable and rapid, I believe, than the history of any other country can show." He says also, that the change has been dramatic ; that there is a highly organised Government in the country ; that there are great churches—700 churches I believe Mr. Samuel mentioned—in the land ; that there are great schools and hospitals, also shops, where any ordinary commodity can be bought ; that one may go among the people alone and unarmed, and everywhere meet with welcome ; and much else of the same kind. Now it strikes one as being very odd, that people should be talking of carrying shiploads of natives so progressive to South Africa, to work in the deep mines. I do not know who started the idea that the Baganda would be fit for mining, or would be willing to leave their own land of beautiful plantations and healthy plateaus, and perpetual sunshine, for service in a land so remote

from them as South Africa is. The change of climate would be death to them. They are not fitted for such work as delving in deep mines. Really it amazes me that, having just built a £6,000,000 railway from the sea to Uganda, English people should be seriously talking of taking the bone and sinew of Uganda to die in South Africa. A large country like this to be deprived of its strongest men, for the benefit of the Johannesburg district! Why, it would be the greatest folly ever heard of, aye, and worse than a folly, it would be a crime. As the author has himself said, in mental capacity the Baganda are far removed from that low level of brutalised stupidity so general among negro races. Now, while we who have the welfare of the Baganda at heart, have looked forward hopefully to the time when we should see a practical return for the £6,000,000 spent on railway and steam communication, in the trade such an active, clever people like this would create with us, in the produce they would raise, in the value of the asset that a people so imitative, so acute in business, so fertile in ideas, would be to a commercial nation as ours, it is unutterably absurd to hear intelligent men talk of arresting this prosperous advance by robbing the land which needs them for the benefit of another colony. We have heard Mr. Samuel's high praise of the Baganda, and it would appear that they have exceeded the expectations of those who first brought them into notice, and those who have laboured among them. Mr. Samuel has cited several instances of their precocity, and that arithmetical conundrum was among the happiest examples of their native astuteness. It is only a few weeks ago I received several copybooks from Mengo, which Baganda children, from six to 12 years old, had filled with their imitations of the headings. I gave one to my own boy of seven to try and copy, so that I might compare his writing with an Uganda child of about the same age, and to my shame, be it said, the Uganda's writing was superior. Mr. Samuel also gave us a graphic sketch of the interior of a church on a Sunday, when filled with its native congregation—the service conducted by one of the great chiefs—and he impressed on us the picture of devoutness and decorum that prevailed. Surely of such a people, turning out in their thousands to keep the Sabbath holy and to worship God, after the manner of Englishmen, we were not far wrong in thinking that they were ordained for something higher and nobler than digging for ore at Johannesburg. The map will show you what a fine position these Baganda occupy. What fields lie about them! fields which some of us have thought would be best cultivated by them to bring their black neighbours into the same church and the same state of Christian feeling as themselves. If undisturbed by such mad ideas as expatriating them for the sake of South African gold, I feel convinced more than ever that the Baganda are destined to be as productive of good to the lands and peoples around them, as England has shown herself to have been for the world at large.

Sir George S. Mackenzie, K.C.M.G., C.B., expressed his thanks to Sir Henry Stanley for his references to the late Sir William Mackinnon.

Mr. R. T. Mallet, M.Inst.C.E., said he had no personal knowledge of the Uganda Railway, or of any of the engineers engaged on its construction, and he held no brief to defend them from the very serious charges brought by Mr. Samuel, of culpable blundering and of reckless waste and extravagance; but as one who had spent his life in constructing railways in India, he felt that, on examination, these charges would be seen to be quite undeserved. The Uganda Railway was of metre gauge, and had cost about £9,000 a mile. The average cost of 4,000 miles of the chief metre gauge railways of India, was £7,200 a mile, and the longest of them, the Southern Mahratta, had cost over £8,400 a mile. The Indian railways were mostly in flat plains, and had abundant cheap labour on the spot. The Uganda Railway crossed most difficult and mountainous country, and all the labour for it, skilled and unskilled, had to be imported from India, as Mr. Samuel had told them. The line was pushed through an unmapped and unexplored country, so it was impossible for the engineers to know what was before them, and what bridges and waterways would be necessary. Therefore, to regard the heavy loss of earthwork caused by floods, as due to blundering, would be a ludicrous error. Under these circumstances the cost of the Uganda Railway must be considered decidedly low. Mr. Samuel had borne testimony that its political importance and usefulness had already become apparent, and it is impossible to doubt that its whole cost has been wisely and profitably as well as economically expended. The merchants, shopkeepers, travellers, &c., from whom Mr. Samuel derived his views of the incompetence of the engineers, were obviously of classes not qualified to form any opinion worth quoting.

Mr. R. B. Buckley, C.S.I., said he was an engineer, but not a railway engineer, and could not be accepted as an expert as Mr. Mallet was. Last year he had travelled over the whole length of the railway and examined it. He was struck with the very great difficulties which had to be encountered by the engineers. The first estimate was well known to be a very imperfect one, and it was necessarily so when a considerable part of the route was not properly surveyed, and, indeed, hardly visited by the engineers. Mr. Buckley could not agree with Mr. Samuel's strictures upon the extravagance of the engineers. He thought the railway a wonderful one, and a magnificent monument to the skill of the engineers.

Mr. Herbert Samuel, in reply, said that he desired to touch upon only two or three of the points which had been raised in the discussion. In the first

place, he must plead guilty to Sir Henry Stanley's charge of omission with regard to Sir William Mackinnon. It would, indeed, be difficult to speak too highly of the value of his services in laying the foundations of British civilisation in East Africa; and of all the men who had received the honour of a statue being raised to their memory, there were few more worthy of that distinction than Sir William Mackinnon, who was worthy of the statue which now stood in the station square of Mombasa as a memorial of his achievements. Sir Henry had also referred to the conditions under which the British East Africa Company had come to an end. Into that matter he would not follow him, except to express his strong conviction that the direct government by the Crown was a far better system, except in rare circumstances, than rule by a chartered company. A chartered company must always have a double duty. It must look to the interests of the people under its care, but it had also to look to the interests of its shareholders, naturally desirous of dividends. Such a division of duty could seldom be satisfactory, and he for one rejoiced that the British East Africa Company, valuable as its services had been, had given place to the direct authority of the British Government in the vast territories which had been under its sway. That the building of the Uganda Railway had been accomplished in the face of grave difficulties, and that its completion reflected great credit on the engineers, he had not only admitted, but emphasised whenever he had spoken on the subject in the House of Commons and elsewhere. But he must still adhere to the view, in spite of what had been said that day, that due regard had not been paid to the claims of economy; and in that view he had been strengthened by the report of Colonel Gracey, who had been sent by the Foreign Office to inspect the railway during its construction. He thanked them very cordially for the reception that they had been good enough to give to his paper.

Upon the motion of the CHAIRMAN, a cordial vote of thanks was unanimously passed to Mr. Samuel for his admirable paper.

Sir FRANCIS O'CALLAGHAN, K.C.M.G., C.S.I., writes:—

I thoroughly agree with Mr. Herbert Samuel's opinions regarding the encouragement of immigration from India, and giving facilities to Indian traders who have acted as pioneers along the whole eastern coast of Africa, and in many cases penetrated far into the interior. I happened to be in East Africa, and for a few days in Uganda, at the time of Mr. Samuel's visit. The Waganda certainly seemed to me to be the only people in East Africa from whom intelligent workmen can be drawn who can replace the Indian navvies engaged on the maintenance of the railway, and while earning good wages, can reduce working expenses considerably. So far, as three to four thousand are concerned, there is no need to go to the South African gold mines to earn fair wages, and it is to be hoped that those of the natives who are able and willing to work, will remain in their own country and help to develop it. The cultivation of potatoes and beans, in which an export trade to South Africa is springing up, if encouraged and developed, may yet prove to be of considerable importance. The only encouragement needed is in the way of cheapening transit, which can best be done by the protectorate authorities constructing roads through the districts which can produce those commodities, so that they may be easily conveyed to the nearest railway station. As the bulk of the present traffic is from the coast towards the lake (Victoria), the railway has numbers of but partially filled wagons going downward, and can afford, therefore, to carry export traffic at comparatively very low rates, while the different steamship companies, calling at Mombasa, are only too glad to obtain freights for the south. There is only one remark of the author's to which I can take exception, and that is the charge of extravagance against the constructors of the railway. He says he consulted administrators, traders, missionaries, doctors, soldiers, and assistant engineers. Why did he not go to the one man in East Africa at the time of his visit, who could have given him reliable information, namely, Sir George Whitehouse, the chief engineer? All but the last are absolutely uninformed in railway construction, and the assistant engineers, who might have some ideas on the subject, are only beginners. Would he, on a knotty law point, consult the last called barrister, or on obscure ailments, consult the young medical man just fresh from college? He says it is not his own view but that of European public opinion. If he wishes to buy the best motor car for a specific purpose, would he consult the "man in the street" or the Surrey magistrates, who are such adepts at setting traps for motorists? I think not. He says the first estimate was for a sum less than £2,000,000, but did he ever inquire by whom and for what description of railway that estimate was made out? It was for a narrow-gauge line, with light rails, and a minimum equipment, something like the first Beira railway, described by the member for Mansfield in the House of Commons last December as a "tin-pot" line, which broke down utterly when the strain of traffic was first put upon it, and had to be reconstructed at an additional outlay, which brought the total cost to over £9,000 per mile; certainly 50 per cent. more than the cost of the first similar length of the Uganda Railway. That first estimate was made by a committee assembled under the orders of the late Lord Kimberley, when Secretary of State for Foreign Affairs. In September, 1895, when the present Committee at the Foreign Office to supervise the construction of the railway was constituted, the instructions given to it were that the line was to be a substantial railway, not an inefficient steam tramway, and that its character in this respect is proved may

be gathered from the fact that until the rails reached the lake terminus the line behind had to bear a traffic of from five to six heavy trains of materials daily. No light line would have survived this strain. As regards expenditure, the author perhaps does not realise that the cost of materials from England, delivered at Mombasa, alone amounted to over two and a-half millions sterling. It is understood that he takes exception to the amount of temporary line laid to facilitate the construction of heavy works, and to hasten the completion of the railway. The hastening of the work was due to orders from the Government, but in any case it was true economy. Had the ten miles of temporary line on the coast section not been laid, the railway would not in 1898 have been able to convey across the Taru desert the relief expedition for Uganda—an expedition which, even with that help, was barely in time to save Uganda from disaster. Had the troops been three days longer on the way they would not have found any Europeans in Uganda to save! Then what would the expenditure on reconquering the country have amounted to? Again, the wire-rope incline laid down the Kikuyu escarpment expedited the laying of rails up to Molo by 18 months, and saved its cost in the reduction of carriage on protectorate stores over that distance alone. The average number of labourers employed during the seven years the line was under construction was about 14,000, and this number could not be usefully employed unless spread over a long length, and could not be fed unless the rail were near. If the rail laying was to wait on the completion of each bridge or heavy cutting or embankment, the waste due to crowds of men being temporarily kept idle would have been enormous, and had the total number been cut down to half (as would have been necessary) the time spent on the construction of the railway would have been correspondingly increased. With the abolition of porterage an end has been put to the loss of human life entailed in crossing the Taru desert, and I may mention that, since the first section of the railway was opened, the difference between the cost to the protectorates of the carriage of stores by rail and that which would have been incurred under the caravan system has amounted to over half-a-million sterling. I have built many hundreds of miles of railway under much less onerous conditions, and never hesitated to lay deviations round heavy works in order to expedite the completion of the whole. The total length of temporary line laid for the Uganda Railway was under 100 miles. The opening of the railway has also put a complete stop to the slave raiding and trading over a wide area. So far from being extravagantly built, the Uganda Railway is one of the cheapest lines of its class in Africa, and will stand comparison with any other.

Mr. HERBERT SAMUEL writes:—Perhaps I may be allowed to add a few lines in answer to the comments of Sir Francis O'Callaghan on the question of the cost of the Uganda Railway. His first criticism on my remarks on this subject is to complain that I did not go to the chief engineer of the railway for a well-informed and reliable opinion. That Sir George Whitehouse's judgment would have been well-informed is unquestionable. That it would have been impartial can hardly be expected. One does not ask the manufacturer of a particular type of motor-car for an unbiassed opinion on the merits of his car as compared with those of others; nor, to vary the illustration, does one regard the advertisements of patent medicine vendors as unquestionable evidence of the real value of their drugs, in spite of the fact that the manufacturers of the medicines might be expected to know more about them than other people. In the same way, it is a strange suggestion that the one man from whom an impartial opinion might be expected on the point whether or not the railway had been economically built, was the very engineer whose administration was the subject of criticism. My contentions, I may add, are supported, not only by the general public opinion of Englishmen in East Africa, but also by the authority of Col. Gracey, R.E., an engineer of distinction, who was sent by the Foreign Office to inspect the railway in 1900-1901, and whose report (printed in Parliamentary Paper, Africa No. 6, 1901) contains numerous criticisms of the lavish manner in which money had been spent on unnecessary objects. The estimate of under two millions was, it is true, for a line of 3 ft. guage and lightly built. But the later estimate for a line such as has been constructed was only three millions, which still compares very unfavourably with the actual expenditure of nearly six millions. With Sir Francis O'Callaghan's remarks on the wisdom of the policy of building the railway, and the beneficence of its results, I cordially agree.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 18, 1903; THOMAS EMLEY YOUNG, B.A., in the chair.

The following candidates were proposed for election as members of the Society:—

Blenkinsop, Edward Robert Kaye, care of Messrs. H. S. King and Co., 45, Pall Mall, S.W., and Raipur, Central Provinces, India.

Draper, Rev. John Thomas, The Manse, East-street, Andover, Hants.

Hogg, John Thallon, A.M.I.Mech.E., Locomotive Superintendent's Office, Natal Government Railways, Durban, Natal, South Africa.

Thorp, John Thomas, 57, Regent-road, Leicester.

Vizetelly, Frank Horace, 200, West 142nd Street, New York, U.S.A.

The following candidates were balloted for and duly elected members of the Society: —

Bodington, O.E., 6, Boulevard des Capucines, Paris, France.
Braine, Charles W., 25, Schubert-road, Putney, S.W.
Chetty, V. Alwar, Trichur, Cochin State, India.
Eason, Vernon, Francistown, Bechuanaland Protectorate, South Africa.
Freire, Dr. José J. da Silva, Officinas de Engenho de Dentro, Estrada de Ferro Central do Brazil, Rio de Janeiro, Brazil, South America.
Fryer, Tom Jefferson, A.M.I.Mech.E., 20, Change-alley, Sheffield.
Harvey, William J., J.P., 21, Mincing-lane, E.C., and Conservative Club, St. James's-street, S.W.
Jones, C. H., Harley-lodge, Enfield.
Muncherji, Colabawalla Behramji, Aden.
Muncherji, Colabawalla Nasserwanji, Aden.
Padar, Pestonji Cowasji, Aden.
Walsh, Cecil J., 6, Regent's-park-road, Church-end, Finchley, N.

The paper read was—

NEW ASPECTS OF LIFE ASSURANCE.

By William Schooling, F.R.A.S.

Last November, Sir William Preece was advocating in this room the necessity of applying to business the methods of science. He reminded us that science was organised common-sense, and he had no difficulty in proving, with abundant conclusiveness, the value of science in commercial affairs.

In bringing the subject of life assurance before the Society of Arts, for, as I understand, the first time, it seems quite appropriate to urge the necessity of applying to this branch of business the methods of science which, in other directions, have been so fruitful of good results.

It is true that life assurance is based upon organised facts, treated by scientific methods. The mortality of the past has been collected with the greatest care, and mortality tables have been compiled with a skilfulness and ingenuity of calculation in no way inferior to the calculations of astronomers. Mortality tables are, in the best sense of the word, scientific productions, and they constitute the basis of life assurance. The organised experience of the past, in combination with the mathematical theory of probabilities, is the foundation upon which the whole structure of life assurance has been raised; and the recognised stability of well-established and well-conducted life offices, affords evidence that the theory of life assurance fulfils one of the strictest conditions by which scientific method can be tested, namely, the power to predict future results. Long and wide experience shows that great corporations, possessing many millions of funds, can work successfully under the guidance of the scientific theory of life assurance, for the development of which the world is indebted almost entirely to the United Kingdom. But when we come to the practice of life assurance, when we consider the arguments that are put forward in its favour, we find that the methods of science are but little recognised.

Comparison.

In the methods of science, comparison is an essential feature. Speaking generally, it may be said that comparison is essential to knowledge, and that the degree of our knowledge of a subject may be measured by the extent to which we have compared it accurately with other subjects.

Stories of uncivilised races illustrate in very happy fashion how essential comparison is to knowledge. The traveller, Hayes, could not make the Esquimaux understand that woollen clothing was not a skin; biscuit they took for the dried flesh of the musk ox; while they thought glass was ice, and imagined it would melt in their mouths. Having so small an acquaintance with things, these were the most rational comparisons they could make. So, when we remember that the Fijians had no experience of metals, we see nothing irrational in the question they put to Jackson, "How could we get axes hard enough in a natural country to cut down the trees which the barrels of muskets are made of?" For they compared musket barrels to tubular canes. So again some Hill people whom Dr. Hooker met ran away in terror when they saw the coils of a measuring tape disappearing into the spring box. Because of its movement they thought it was alive, and because of its shape and behaviour they thought it was some kind of snake. When the natives of Lower Murray first saw pack oxen some of them were frightened, and took them for demons with spears on their heads, whilst others thought they were the wives of the travellers because they carried the baggage. In all these cases we see that the errors that resulted were due to the comparisons being incomplete, and not to the comparisons that were made being wrong. Glass is rightly compared to ice, as far as general appearance, hardness, and trans-

parency are concerned, and musket barrels to canes, since both are tubular; while pack oxes and the wives of savages are comparable, inasmuch as both carry baggage. Still, if incomplete comparisons are taken for complete ones, the result is wrong, however correct the comparisons that are made may be.

There are three distinct directions in which comparisons in connection with life assurance may be made with advantage. In the first place we may compare the progress of insurance in general, and of life assurance in particular, with the principles of evolution or progress, which Mr. Herbert Spencer has shown to be characteristic of all phenomena.

In the second place we can, with advantage, make a more concrete comparison of life assurance with closely related subjects, such, for instance, as investment in stock and shares.

And in the third place we can practise life assurance to the greatest advantage, by making adequate comparisons between the results to be obtained from different life assurance companies.

The Evolution of Life Assurance.

In a brilliant trilogy of addresses, Mr. T. E. Young, a former President of the Institute of Actuaries, and our Chairman, this evening, has applied the theory of evolution to the system of life assurance.

It will suffice to indicate briefly a few, out of many, characteristics which are common, both to evolution in general, and to life assurance in particular. You will, of course, recognise, that if the general theory of evolution is rightly stated, it must apply to every phenomenon; and the fact that I merely show the coincidence in certain respects, involves no suggestion that the general theory of evolution does not apply in every detail to the subject of life assurance.

One of the characteristics of progress in general, is a change from incoherence to coherence, and from an indefinite to a definite condition. Astronomers have taught us that the beginnings of worlds and solar systems are to be found in vague irregular masses of nebula; that little by little the scattered masses of nebula come together in clusters, which gradually become more and more definite in outline, attracting to themselves the isolated streams and cloud wisps scattered round them, until, sometimes in rings, sometimes in shining globes, the outer parts are left behind as the centre cluster draws its scattered parts more closely together. The nebula at first, almost shapeless in outline, and with no seeming harmony among its parts, changes little by little into a more shapely mass, shining in great brilliance, glowing more in its central parts, and shading off by delicate gradations, till it is almost imperceptible against the dark background of the space beyond. In later changes the centre part grows brighter and more bright; the outer parts also become brighter and more definite in outline, until they, too, draw together into brilliant globes, separated from the central mass, and only indicating their connection with it by moving as it moves, and turning as it turns.

Thus from the vagueness of the original nebula evolves the definiteness of a solar system and its attendant planets. It is no fanciful allusion to compare the primitive vague of life assurance and the subsequent definiteness to which it has attained, with the evolution of nebulæ into the definiteness of suns and planets. These phenomena, so different in character, are both illustrations of the same general law of progress, which consists, among other things, of a change from the indefinite to the definite.

Turn back to the early records of life assurance, and you find that the premium charged for assuring a given amount at death varied but little, if at all, with the age of the person assured. It was scarcely recognised in early days that age was a factor to be taken into account. Consider again, that even when some importance was attributed to age, no distinction was made between the purchasers of annuities and the purchasers of life assurance policies; and that the charges made to both these classes were based upon the mortality of the general population. The result of this indefiniteness, of this failure to distinguish between the duration of life among annuitants and among assured lives, was forcibly brought home to sundry corporations which raised money by means of annuities, on terms which involved the corporations in the loss of extremely large amounts. At the present time the rate of mortality among annuitants is recognised as being altogether different from the rate of mortality among either assured lives or among the general population. The primitive indefiniteness has given place to definiteness and exactitude, based upon a comparison of past experience, founded upon knowledge that is organised.

There is one other feature of progress in general to which I will refer in some detail: it is the change from simplicity to complexity. Let us stand in imagination by the camp fire

of some primitive tribe, and listen to the record of the fighting or the hunting of the local heroes. We are witnesses, did we but recognise it, of the origin of history, the commencement of oratory, the beginning of poetry, the dawn of music, the birth of song, and the earliest of dances. If we trace the development of these primitive records to the stage which they have reached in our own day, we arrive at modern journalism, at the work of historians, at the current developments of vocal and instrumental music, at the complex elaboration of modern theatres, and at the present ramifications and developments of local government and of Imperial parliament. The simplicity of primitive life has developed by the most gradual stages into the vast complexity of our modern environment.

Life assurance also exhibits an astounding progress from the simple to the complex. The first conception of insurance was apparently some mutual combination for compensation in the event of loss of vessels at sea. It was followed by combinations which provided payment to individuals for damage to property by fire. Later on, it was extended to the making of payments to the wives and families of policy-holders at the death of the persons assured. In our days, there is scarcely a contingency, whether of death, sickness, accident, fire, or of any other kind, that cannot be provided against, from a financial point of view, by means of insurance. Truly the simple has become complex to so great an extent that a lifetime devoted to the study of the subject is scarcely adequate to follow it in all its details.

A necessary accompaniment of this change from simple to complex is the process of differentiation which is exhibited in progress in general, and is clearly seen in connection with life assurance. If we go back to the primitive condition of life we find each man building his own dwelling, making his own weapons, obtaining his own food, making his own clothes, and, in fact, performing for himself all the few functions that were necessary to his condition of life. It is unnecessary to trace the changes that have taken place, and which have resulted in the division of labour characteristic of modern existence. Nowadays one man plays but a small part in the production of one, out of many, articles of food; in the manufacture of one, out of many, kinds of weapons. In literature, in journalism, in science, in manufacture; in fact, in every department of human activity, we see individuals specialising in some one limited direction. This specialisation, when carried to an extreme, may tend to the detriment of individuals, but it is undoubtedly beneficial to the community at large. We may regret that individuals are converted into machines for making one small part of many thousands of boots, and that people are employed through all their working hours in the constant repetition of some one process, which, after much practice, becomes almost purely mechanical. There is, however, compensation to be derived from the thought that this differentiation, this specialisation, tends to reduce the hours of labour, and to provide more leisure, which can be, and very frequently is employed in the voluntary exercise and enjoyment of higher faculties.

This process of differentiation has proceeded far in connection with insurance matters. We not only have companies specially devoted to different branches of insurance, such as life, fire, accident, burglary, and many other departments, but in each company the members of the staff are specialised for the performance of some small part of the work.

I think we can trace distinct benefits to this specialisation. Speaking generally, it will be found that companies which confine their business to life assurance generally give better results to their policy-holders than offices which transact many different branches of insurance business.

Among the offices transacting life assurance only we have further differentiation in the class of people catered for, or the nature of the business undertaken. Some companies devote themselves especially to the industrial classes; some to the clergy and their relations; and others to those who have a common bond in connection with education or habits. Again, speaking generally, it is found that these extra specialised companies usually produce exceptionally good results.

A further specialisation is to be found in the different features of life assurance to which some offices pay particular attention; some companies give relatively superior results under endowment assurances, and relatively inferior results under whole life policies. The single premium rates are in some cases exceptionally low, while, in the same office, the rates for annual premiums are above the average. Again, some companies, as a result of either their premium rates, or their bonus system, are exceptionally good for people entering at the

older ages, and relatively bad for those who effect their policies when young, and *vice versâ*. For the most part, in talking of differences of this kind it cannot be argued that they are advantageous to the company, or that they are evidence of merit of progress. It should be, and it usually is, the aim of every actuary of a life office, to deal justly with every class of policy-holder, and not to favour one at the expense of the other.

There is, however, a point of view from which such differences as I have just described are to be regarded as a distinct advantage. In the selection of a policy, comparisons should be made between the results likely to be yielded by different offices, and advantage should be taken of the exceptional benefits given to particular classes of policy-holders, or to entrants at particular ages.

A further *bona fide* development, of which we have not yet seen much indication, is that of the specialist in life assurance, who is familiar with the best points of all the companies, and to whom intending policy-holders can apply for advice upon the subject.

The Differences Between Life Offices.

It must not be supposed, however, that the differences between the results given by life offices are wholly, or even principally, due to accidental errors, or peculiarities, in premium rates or bonus systems. There is a far more important and most satisfactory differentiation due to the financial strength of different companies. As we shall presently see, those offices which are financially the strongest, are normally those which give the best results to their policy-holders, and signs are not lacking to show that quality in a life office is being more and more appreciated, with the result that the best offices are growing better, inferior offices are becoming worse, and the distinction between them more and more marked.

It is fairly obvious how such results are being brought about. One important factor in the prosperity of a life office, is economy of management. If we examine the rate of expenditure of many of the best companies, we find that it is decreasing, in spite of the outcry that is frequently heard about the keenness of competition, the consequent heavy cost of obtaining new business, and the need of paying extravagant rates of commission in order to secure it. That exorbitantly high rates of commission are frequently paid, is beyond question, and many companies are obtaining a large volume of new business which must inevitably be detrimental to existing policy-holders. The benefits to be derived from the more favourable mortality of lives which have recently been medically examined, cannot by any stretch of the imagination be regarded as sufficiently great to compensate for the heavy rate of expenditure sometimes involved in obtaining them. Some apparently reliable statistics as to the value of new lives in consequence of their more favourable rate of mortality, bring out 40 per cent. of the first year's premium as the cost which it is worth while to pay for new business. The average expenditure of British offices is 80 per cent. of the first year's premium, and that of many companies exceeds 100 per cent. Whatever opinion may be formed as to the accuracy of the estimate of 40 per cent. of the first year's premium as the value of new lives, I think it is altogether beyond question that an expenditure of 100 per cent., or even 80 per cent., of the first annual premium can only be made at the cost, and to the detriment, of existing policy-holders. It ought to be a truism that, at least in a mutual society, the welfare of existing policy-holders is the primary consideration of the management. Too frequently this is not the case—there is an eagerness for quantity, at the expense of quality, of business which surely, if sometimes slowly, tends to the detriment of an office. The consequent loss of quality increases the expenditure necessary for obtaining the desired amount of new business; such increased expenditure deteriorates still further the quality of the company, and again augments the expenditure incurred.

In various ways heavy expenditure, and a large accession of new business, tends to prevent the valuation of the liabilities on a stringent basis, and by so doing causes the sources of surplus to remain small and the results yielded by the policies to be inferior to those of other companies. In such ways as these differentiation between the superior and inferior offices is being more and more accentuated.

It cannot be said that the general public makes much sensible discrimination between offices likely to yield good results and offices that will probably give inferior results. There are, perhaps, a few signs that a small proportion of intending policy-holders take some pains to select the best offices; and it is to be hoped that in course of time people will learn to discriminate much more than they now do in the selection of their life assurance policies.

DISSOLUTION.

When viewed on a sufficiently extensive scale all phenomena exhibit an era of evolution followed by an era of dissolution, and, but for the ignorance, or the stupidity, of policy-holders the era of dissolution as applied to some of the existing life assurance companies would now be in progress. The dissolution of inferior companies would promote the beneficial evolution of superior offices, and the sooner this era of partial dissolution sets in the more advantageous it will be for policy-holders as a whole.

We have already discussed the possible dissolution of some insurance systems working on wrong lines. The Tontine system, whereby all the profits went to the survivors, and nothing was paid to the estates of those who died, was, it is true, a travesty, indeed the exact opposite, of real life assurance, and after a temporary popularity, it entirely disappeared. In recent years, however, the practice of applying the Tontine system to bonuses, though not to the original sum assured, has been energetically pushed into considerable prominence. But the application of this principle even to profits only is in distinct opposition to the fundamental conception of mutual life assurance. We may look at the matter in another way, and say that that part of the premium which is paid for assuring the face value of the policy is practically a bet that a man will die soon—a process of gambling with an anti-gambling object; while the other part of the premium, which is paid for the right to participate in the surplus, only in the event of the policy-holder surviving for, say 20 years, is practically a bet that he will live long, and is gambling, pure and simple. The two parts of the premium are invested on diametrically opposite principles. I feel confident that the plan of giving participation in surplus only to those who survive a more, or less, lengthy period, will, in the near future, be recognised as opposed to the true principles of life assurance, and will pass out of existence, so exhibiting a further instance of the suppression of the unfit, and of that process of dissolution to which reference has just been made.

These references to dissolution suggest somewhat speculative considerations, by no means devoid of interest.

If once again considering the phenomena with which astronomy makes us familiar we attempt to forecast the future of the solar system, we are led to suppose that in the course of long ages the heat of the sun will gradually be dissipated, and with its attendant satellites, which may or may not some day be absorbed into the parent mass, it will become a cold, dark star, travelling with inconceivable velocity through the depths of space. Of the present existence of such dark stars the observations of astronomers afford ample evidence, and it may be that after the dissipation of motion, characteristic of an era of evolution, has brought them to this condition, some kind of grazing collision may occur which will generate sufficient heat to once again convert them into nebulæ, and cause another era of evolution following upon an era of dissolution. Thus there is suggested the conception of a past, during which there have been successive evolutions analogous to that which is now going on, and of successive dissolutions, of which astronomy supplies evidence on the grandest scale, and which in smaller ways are exhibited in history and in current experience, and of a future during which successive other such evolutions and dissolutions may go on, ever the same in principle, but never the same in concrete result.

It is not difficult to imagine a future condition of human affairs such that the great benefits at present afforded by life assurance may no longer be needed. Through the slow process of social improvement, which is being brought about, not by agitation or legislation, but by each one mending one and that one himself, we may ultimately arrive at such a triumph of altruism, or rather, at so wise a conciliation of egoism and altruism, that the need for life assurance may pass away. This, however, is a possibility of a remote age with which we have no practical concern.

This inadequate outline of the way in which the development of life assurance corresponds with the process of evolution in general is, I venture to think, full of interest and of practical value. The theory of evolution in general has been seen to apply to life assurance in particular, and affords ample proof that life assurance has reached a very high state of development. To my mind it adds immensely to the interest of the subject to compare it with the development of worlds, with the evolution of animal life, and with the progress of all human activities. Viewed in this way, life assurance ceases to be an isolated phenomenon characterised by prosaic dullness, and takes its place as a striking example of the beneficial results of the working of natural laws, which, in other spheres, interest and attract us by the

wonderfulness of their operations, and the advantages of their results.

Adaptation to Circumstances.

Leaving these somewhat general and abstract considerations, we may appropriately notice the operation in life assurance of those principles of adaptation to circumstances which supply us with some of the most fascinating stories of natural history. Beneficial modifications, occurring in plants or animals, lead to their survival, and to their selection as the progenitors of other organisms that inherit their improved variations. Nature developes in this way many diverse methods of accomplishing many diverse objects. Thus wide diffusion of seeds, being of advantage to the species, is effectively accomplished in different ways. Some develop wings or hairs that enable them to be carried far and wide by the wind; while others have curious hooks or prickles by which they become attached to the fur of mammals, or the feathers of birds, and thus secure diffusion. In a similar way the colouration of animals is sometimes such as to make them indistinguishable from their surroundings, sometimes such as to make them exceptionally conspicuous; but in both cases affording protection or other advantages. The benefit of the species is the invariable end, but the means employed are indefinitely numerous. In the arctic regions there is a remarkable prevalence of white in animals, permanently displayed in the polar bear and the snowy owl, living always in the snow; but only white in winter time in such animals as the arctic hare, the ermine, and the ptarmigan, that inhabit regions which are free from snow in summer. Musk sheep, on the other hand, are brown, and conspicuous against the arctic background; but as their safety depends upon association with their fellows in herds, which by united effort can protect themselves from attack, their safety is best secured by being readily seen and recognised by their companions.

Among the most familiar instances of such adaptation to circumstances, are insects so closely resembling leaves, or twigs, that the natives of Java and Ceylon refuse to believe that they are insects, and insist that the twigs have begun to walk. Not only is the walking leaf insect almost indistinguishable from the surrounding foliage, but its eggs bear a very close resemblance to seeds.

In aquatic life, we meet with shrimps and crabs, which swarm in the gulf weed, and are exactly the same shade of yellow as the weed, while white markings on their bodies increase the resemblance to their floating home.

It would be easy to multiply such examples of advantageous adaptation to circumstances, but the important point for us to recognise is that adaptations no less ingenious, advantages no less important, are exhibited by life assurance.

Insurance and Gambling.

Only a few weeks since, a distinguished writer told me that he regarded life assurance as a process of gambling, not quite so bad as betting on horse races, but a little worse than speculating at Monte Carlo. That life assurance is a process of gambling such as is commonly called "hedging" is a statement that cannot be disputed, but it is worth while to notice the true significance of this fact. Unless we do this our comparison of insurance with gambling is incomplete; we are like the Esquimaux comparing glass with ice, and our conclusions, correct so far as they go, would lead us to a wrong result in consequence of our comparisons being incomplete.

I know of no better definition of gambling, from a scientific point of view, than that it is a change from certainty to uncertainty. We part with the certain possession of the price of a ticket in a lottery in exchange for the chance, the uncertainty, of winning a prize. If the lottery is a fair one, as, for instance, when the prize is £1, and there are twenty tickets sold at 1s. each, the chance which we purchase is worth exactly what we pay for it. In betting on horse races people seldom recognise that the chance which they purchase for the amount of their stake is not worth nearly so much as it costs. I once examined the odds on a large number of horse races, and found that the average value ot the chance purchased by each £1 was mathematically worth about 14s. 6d. It is foolish to exchange a certainty for an uncertainty, even when the uncertainty obtained is worth what it costs; but it is still more foolish to pay £1 for a chance that is worth less than 15s. If, therefore, life assurance were a process of gambling, properly to be compared with betting on horse races, I should condemn it as foolish in the extreme; but notice the consideration that is necessary in order to make our comparison complete.

The duration of life of each individual is uncertain in the extreme, and mortality tables, while affording reliable indications of the average duration of life of a large number of

people, give no indication of the probable duration of life of any individual.

In a very large number of cases the death of an individual, especially of a man, involves financial loss to those dependent upon him, and, consequently, those dependants are in a position of uncertainty, in the position of gamblers, in consequence of the uncertainty of the time of death.

Life assurance converts this financial uncertainty into a financial certainty, and, consequently, we adopt a process of gambling to escape the position of gambler in which we are placed by nature. You will see that when in this way we make our comparison complete, insurance, while a process of gambling, is the exact antithesis of such forms of gambling as take place on a race-course, or at Monte Carlo. The real gamblers, the people who prefer uncertainty to certainty, are those who abstain from insurance.

Further Adaptations.

But now notice the ingenious adaptation to circumstances which is revealed in the system of life assurance. A life office relieves individuals of financial uncertainty, but, owing to the uniformity of the average duration of many lives, the company does not place itself in any position of uncertainty. It finds itself in the same situation as the person who buys all the tickets in a lottery, thereby eliminating chance. It is strange that we should admire ingenious adaptations to circumstances in plants and animals, and that when we see the same law operating in a different sphere, supplying an adaptation to circumstances fully as ingenious, and just as perfect in its operations, we should withold our admiration, and abstain from the benefits it can confer upon us.

The individuals in any species of plants or animals that do not acquire the protective colouring, or other characteristics, tending to the preservation of the species, go under in the struggle for existence. It is altogether too lamentably true that individuals of the human species who abstain from the protection afforded by life assurance, also go under in the struggle for life ; or rather it is worse than this. The man abstains from the protection afforded by natural law working in the social sphere, and his wife and family go under in the struggle for life, to the accompaniment of suffering for the individual, and detriment to the species or community.

Another illustration of ingenious adaptation to circumstances in life assurance is to be found in the fact that the payment of the first annual premium on a life policy secures an immediate capital of a relatively large amount. A man may pay £35 to-day, and may die to-morrow, with the result that his family will receive £1,000 ; and, what we have particularly to notice, is that this great benefit to the individual is accomplished without any loss to the society which makes the payment. Premature deaths are a natural part of the working of the law of average ; so much so that it may even be said that the whole system of life assurance would be impossible, and the vast benefits which it confers be unattainable, were it not for the unequal duration of different lives of the same age.

Life assurance is unique in supplying in this way a large benefit in return for a small payment, and it is unique in another way, which further illustrates the ingenious adaptation of means to ends. A life office, alone among financial institutions, yields the most profitable returns when the margin of security provided is the greatest. In dealing in stocks and shares, when dividends are high and security is great, the price of stock rises, with the result that the interest yielded upon the purchase price is small. Good security and good dividends do not go together. In life assurance the contrary is true ; the offices which are financially the strongest are those which yield the most profitable returns to their policy-holders.

We all know that life assurance companies make periodical valuations of their liabilities. They calculate on a given basis the amount of funds which it is necessary to have in hand at the present time in order, that, with the addition of the interest earned upon them, the sums assured under policies may be paid as they become due. They next estimate the present value of the premiums to be received in the future, and by deducting the present value of the future premiums from the present value of the sums assured, determine the liability of the company.

If, in making such a valuation, a rate of interest is adopted in the calculations which is lower than the company is likely to earn upon its funds ; if in calculating future mortality a less favourable rate is assumed than is likely to be experienced, and if in making provision for future expenses a higher rate of expenditure is provided for than is likely to be incurred, the net liability of the company works out at a larger amount than would be necessary for the fulfilment of all its obligations.

The greater the margin between the interest assumed in the calculations and the interest earned upon the funds; the larger the difference between the rates of mortality provided for and experienced; and the greater the excess in the provision for expenses over the expenditure incurred; the larger the liability will appear, the greater the reserves will be and the more extensive the margin for security.

But now notice what happens when the next valuation comes to be made. Actual experience in regard to interest, mortality, and expenditure having proved more favourable than was calculated upon, a surplus remains which is available for distribution to policy-holders in the form of bonuses. The more stringent the basis adopted in valuing the liabilities, the greater is the margin for security, and the larger the surplus.

In spite of these great and wholly exceptional advantages, which can only be arrived at after successful working for many years, anyone is free to become a member of a successful and old-established company without paying extra for the privilege. He can participate, not merely in such results of a successful past as I have just described, but can share in the miscellaneous profits of a prosperous business that has been long established. The sale of non-participating policies, and of annuities, and certain other features of the trading of a life assurance company, yield substantial profits, in which a new policy-holder is entitled to share, although he has incurred no risk, and has had no part in developing the business which yields the profits

Such an advantageous state of affairs for new members is without parallel in other financial institutions.

There are further exceptional advantages, further ingenious adaptations to circumstances in the remarkable security afforded by a well-established and well-conducted life office. Professor de Morgan said, long ago, "There is nothing in the commercial world which approaches, even remotely, the security of a well-established life office." This statement is often quoted, but, perhaps, few people recognise the literal accuracy of the statement, and the overwhelming cumulative evidence which can be brought in proof of its truth. As already explained, the basis of life assurance is the mortality table, which can be relied upon with confidence. Another element of large importance is the rate of interest to be earned upon the funds. This can be foretold with some degree of accuracy, while, as just explained, a large margin is allowed to provide, not merely for security, but for future surplus. Many companies are valuing their liabilities on the assumption that the rate of interest to be earned in the future, is only $2\frac{1}{2}$ or 3 per cent., while the funds, both invested and uninvested, are yielding $3\frac{3}{4}$ per cent. or more, after deduction of income tax.

The liabilities of a life office, for the most part, fall due at distant and known dates; hence any exceptional circumstances, such as a large decline in the rate of interest, can be easily and certainly provided for. Moreover, the funds of a successful life office normally increase from year to year, so that permanent investments can be made with advantage, yielding a higher rate of interest than can be obtained from liquid assets, such as banks require to hold in large proportion, in case of a "run" being made upon the banks.

A further element of security is to be found in the fact that about 83 per cent. of the assurances in force in British offices is effected on the system which gives participation in surplus. For such policies a higher rate of premium is charged than is necessary to provide the face value of the policies, and a failure to fulfil the contract to pay this face value can only take place after the whole of the extra premium charged for participation in surplus has been absorbed in meeting extravagant expenditure, or such improbable contingencies as the long continuance of an excessive rate of mortality, a permanent great decline in the rate of interest earned, and serious losses on investment.

It is not inappropriate to refer to the favourable circumstances under which British life assurance is conducted. The Life Assurance Companies' Acts provide that full publicity shall be given to the affairs of life offices, while the management of their affairs is in no way interfered with by legislation. There are few Acts of Parliament which have worked so satisfactorily as the Acts referring to life assurance companies. They have brought about publicity, with consequent criticisms in the press, and in other ways which have the healthy effect of making the extension of inferior companies increasingly difficult; but the absence of Governmental interference, such, for instance, as the imposition of an uniform standard for reserves, has left the companies free to develop on their own lines, with the results that the security of British life offices, and their bonus prospects

for the future, are superior to those of any other life assurance companies in the world.

Immediate Income from Life Assurance.

It is time to pass from these somewhat general considerations in favour of life assurance to some concrete examples of the benefits which it confers. Among those benefits the provision of the sum assured, after the death of the person assured, holds the first and most important place. But while recognising and emphasising this fact it will perhaps be more interesting and more useful to give some illustrations of less familiar ways in which life assurance may be employed to advantage. In my judgment we have scarcely begun to recognise the extensive field which life assurance is destined to occupy.

The reduction in the rate of interest upon Consols; the decline in the value of many gilt-edged securities, and in the return that can be obtained upon them, suggest great opportunities for using life assurance as a means of investment yielding immediate income at a satisfactory rate, accompanied by a security unsurpassed, in some ways unequalled, even by British consols.

The above Table shows various ways in which a man forty years of age can invest £1,000 so as to yield an immediate income. In each system shown in this Table the whole amount invested is returned at death. In the first Table the income yields a return, uniform throughout life, at the rate of £3 17s. per cent. per annum. Such a result can be obtained in two ways. We can either pay a single premium, assuring £1,000 at death, and use the balance of the £1,000 to purchase an annuity for life, which constitutes the income derived from the investment; or we may pay the first annual premium out of the £1,000, use the rest of our money to purchase an annuity, and pay the subsequent annual premiums out of the annuity. The difference between the annuity and the premium constitutes the annual income. Sometimes one method, and sometimes the other, yields the better result; and the choice of method largely depends upon the age of the investor. The amount of the income varies little with age, since, though the premium for assuring a given amount increases with age, the annuity that can be bought for a given sum also increases with age in about the sume proportion. Such an investment as this is normally intended to be permanent, but at the same time it constitutes a security which can at any time be realised or borrowed upon.

Immediate Income from Investment of £1,000.

Age of Investor 40.

Age Attained.	Annual Incomes.				
	Table A.	Table B.	Table C.	Table D.	Table E.
	£ s.	£ s.	£ s.	£ s.	£ s.
40—45	38 10	33 8	29 12	25 0	20 8
45—50	38 10	33 8	37 18	33 6	28 14
50—55	38 10	33 8	39 10	34 19	30 8
55—60	38 10	33 8	41 2	36 10	31 18
60—65	38 10	33 8	44 6	59 9	74 12
65—70	38 10	60 15	47 2	62 5	77 8
70—75	38 10	60 15	51 10	66 13	81 16
75—80	38 10	60 15	56 8	71 11	86 14
80 till death	38 10	60 15	Increases	Increases	Increases
Cash at death	£1,000	£1,000	£1,000	£1,000	£1,000

The next Table (B) suggests an adaptation to circumstances not easily obtained by other systems of investment. If a man contemplates retirement from profession or business say, at 65, he may be well satisfied to draw 3¼ per per cent. upon his money during the working years of life, with a view to obtaining more than 6 per cent. upon retirement. This result is accomplished by taking a policy subject to the payment of only twenty-five annual premiums. The amount of each premium is of course higher than when premiums are paid

for the whole of life, and the difference between the annuity and the premium is less. After twenty-five years, however, the payment of premiums ceases, and the whole of the annuity becomes available as income.

The third Table (C) shows a method of obtaining a gradually increasing income. The policy is taken with full participation in surplus, and the bonuses, declared quinquennially, are employed to reduce the premium for the next five years. Thus at quinquennial intervals the premium becomes less, the difference between the annuity and the premium becomes greater, and the result is a gradually increasing income.

The last Table (E) is the result of taking a policy subject to only twenty annual premiums, and using the bonuses to decrease the premiums for each succeeding five years. Such a premium is relatively high, and the returns to commence with are comparatively small. But after twenty years the payment of premiums ceases, and the income increases from just over 3 per cent. to about $7\frac{1}{2}$ per cent. upon the amount invested.

The fourth Table (D) is intermediate between the third and the fifth Tables, and is arrived at by investing £500 by method C. and £500 by method E.

Such plans as these can be varied to an indefinite extent to suit the probable requirements of any investor.

Under the plans already described the total amount invested is repaid in cash at the death of the investor; but it not infrequently happens that, when a substantial amount is available for investment, some error of judgment leads to its being lost, and many men would meet all necessary requirements by leaving an assured income for, say, twenty years. Several life assurance companies now undertake to pay the sum assured by equal annual instalments, spread over any desired number of years, allowing interest upon the capital which they retain. By adopting this method money may be invested with absolute safety to yield from $4\frac{1}{2}$ to 5 per cent. during the lifetime of the investor, and for twenty years after his death. The next Table shows the results of this system for investors of various ages.

This method, like practically all life assurance systems, is capable of indefinite modification. The income may be larger during the lifetime of the investor, and smaller later on; or *vice-versa*; and the income may continue for a longer, or shorter, period than twenty years. Another modification is, that the investor can, if he chooses, provide for the income to be paid for, say, twenty years after his death as a certainty, and to continue thereafter during the lifetime of a specified beneficiary, in the event of the beneficiary surviving the investor by more than twenty years.

AMOUNT INVESTED, £1,000.

Age of Investor.	Income during Life.		Income for 20 Years after Death.	
	£	s.	£	s.
30	44	1	44	1
40	46	0	46	0
50	48	1	48	1
60	51	19	51	19

There is an adaptability in life assurance systems which enables the most diverse circumstances to be met in remarkable advantageous ways.

These examples are sufficient to show that life assurance, when well selected, constitutes an excellent investment, which can be suitably adapted to the special circumstances of any investor.

Of course it must not be supposed that any extravagant rate of interest can be obtained from investment in life assurance. Excluding the value of insurance protection and rebate of income tax on premiums, the maximum return that can be looked for at the present time, is about $3\frac{3}{4}$ per cent., and such a result as this can only be accomplished by the most careful selection of the best points of two or three different offices. But investments may be so chosen as to meet the circumstances of particular policy-holders in exceptionally effective ways, and when the complete security provided is taken into account, it will be recognised that such a return as $3\frac{3}{4}$ per cent. is remarkably good.

THE VALUE OF INSURANCE PROTECTION.

There are other methods of investing in life assurance which, either with, or without, the provision of an immediate income, guarantee, in the event of premature death, the payment of a much larger sum than has been invested. In this connection it is essential to recognise the value of insurance protection. The man who buys a ticket in a fair lottery receives a chance which is mathematically worth what he pays for it, and the man who purchases a life assurance policy, guaranteeing, in the event of premature death, a larger sum than he has paid in premiums, acquires a chance of

having a much larger sum paid to his estate than he has paid in premiums. The value of this protection is very considerable, and must not be overlooked in comparing certain forms of investment in life assurance with investment in stocks or shares. The value of this protection varies greatly with the age of the person assured, and when this is taken into account, the maximum return that can be expected upon the amount invested, either as immediate income, or in the form of accumulated savings, can seldom, if ever, exceed three per cent. But it must not be forgotten, that, in addition to this three per cent., insurance protection has been received, which is not only of great value to each individual, but which necessarily involves very substantial cost to a life assurance company.

We may illustrate this point by considering a well-selected endowment assurance policy, effected at age 25, and maturing at age 50, or at death if previous. For a premium of £10 per annum, such a policy would yield the results shown in the next Table :—

the amount of the policy was £260, and the premium paid was £10, so that they had a chance of receiving £250 more than they had paid, and so on in subsequent years, the difference between the sum assured and the total of the premiums paid accumulated at 3 per cent. compound interest, gradually decreasing, until in the twenty-fifth year of assurance there was no insurance protection at all, the amount to be paid then being only the total of the premiums paid accumulated at 3 per cent.

This insurance protection, this chance of receiving 60 per cent. or 20 per cent. upon the premiums paid has a definite value, which ought to be taken into account in comparing investment in life assurance with investments of other kinds.

We may appropriately compare life assurance protection of this kind with the protection afforded by a fire inurance policy. No rational man who is insured against losses, or damage, by fire considers that his premium is wasted if no fire occurs. He recognises that he has received insurance protection, that this

Results under an Endowment Assurance Policy Effected at Age 25, and Maturing at Age 50 or Previous Death. Annual Premium £10.

If policy matures in	5 years	10 years	15 years	20 years	25 years
The sum paid is	£281	£303	£325	£349	£376
This equals compound interest at............	60 per cent.	20 per cent.	9 per cent.	5 per cent.	3 per cent.
The claims per 1,000 are .	34	39	43	47	837

Taking no account of policies lapsed, or surrendered, this Table shows that, according to the Healthy Males' Mortality Table, thirty-four out of every thousand persons die within five years, and their estates receive an amount equal to all premiums paid, acccmulated at compound interest at the rate of 60 per cent. per annum. This is the return to those who die at the end of the fifth year ; those who die sooner receive even a higher rate of interest.

The mortality table shows that 39 of the original 1,000 assured die during the next five years, and they receive compound interest on their premiums at rates varying from a maximum of 60 to a minimum of 20 per cent. per annum. The 837 who survive the twenty-five years receive back all premiums paid in addition to compound interest at 3 per cent. per annum.

We may consider the case of the survivors in another way. In the first year of assurance

protection is of necessity costly to the insurance company, and that by securing such protection he has had good value for money. Precisely similar conditions apply to the life assurance protection which we have been considering.

If we calculate the value of the protection in this policy on the basis of 3 per cent. interest, without making any provision for expenses, we find that the net cost to the insurance company, and the actual value to the policy-holders, comes to £43. The commercial value of the protection is more than £43. This amount should be added to the £376 received by each survivor, making the total return £419, which is equivalent to the return of all premiums paid, accumulated at 4 per cent. compound interest.

Insurance and Income Tax.

This, however, does not exhaust the benefits of life assurance considered as investment.

You are, of course, aware that, provided the amount paid in premiums does not exceed one-sixth of a man's income, he can claim rebate of income tax upon the premiums paid. With income tax at 1s. 3d. in the £, he can claim a rebate of 12s. 6d. per annum upon a premium of £10, consequently, the net cost of the benefits we have been considering, is not £10 a year, but £9 7s. 6d.; and for £9 7s. 6d. per annum to accumulate to £419 in twenty-five years, it is necessary that compound interest should be earned upon it at the rate of over 4½ per cent. per annum. Consequently, such a policy as I have just described is really equivalent to an investment, unsurpassed for security, yielding compound interest at the rate of 4½ per cent. per annum.

How the Results are Obtained.

Some of you may naturally ask how it is possible for such results to be accomplished, considering the present rate of interest that can be obtained upon high-class securities, in which alone life offices can invest their money. We have just seen that the income-tax regulations make a difference of one-half per cent. per annum, while the income tax is at so high a rate as it is at present. It is, therefore, only necessary to show how it is possible for a life office to pay the expenses of management, and yet give to its policy-holders benefits which are equivalent to a return of all premiums paid, accumulated at 4 per cent. compound interest. In considering the question of security we have seen that the strongest life offices hold larger reserves than are necessary for meeting their liabilities. For instance, if a company calculated that its funds would earn interest at the rate of 3¾ per cent., it would require to set aside reserves amounting to say £8,850; but, if, in valuing its liabilities, interest at only 2½ per cent. were calculated upon, the reserves would be £10,000. Now in actual practice about 3¾ per cent. would be earned upon £10,000; this would amount to £375 a year, but £375 a year is equivalent to nearly 4¼ per cent. upon £8,850. In other words the reserves are so strong that the interest upon £1,150 is available as a contribution to surplus from funds which are not required for the actual fulfilment of the company's contracts. Strong reserves of this kind have been gradually accumulated as the result of a successful past and all policies, new and old, have a share in the interest upon them. Were it not for the interest derived from these surplus funds, it would not be possible for life assurance companies to give such good results as those we have been considering. Another contribution to surplus is derived from the expenditure provided for being greater than the expenditure actually incurred. There are cases in which future expenditure is calculated to be 10 per cent., or more, above the actual expenditure provided for in valuing the liabilities. Consequently this 10 per cent. of the premiums forms an annual contribution to surplus, and the provision for so high a rate of expenditure as is sometimes assumed in a valuation is only possible as the result of a successful past.

In addition to the benefits derived from the gradual accumulation of strong reserves there is in many cases the trading profit which results from the sale of non-participating policies and annuities, and in some instances from other sources, such as the lapse and surrender of policies. Frequently, also, an increase in the capital value of the assets takes place, especially in connection with money invested in life interests and reversions, which are peculiarly suitable for life assurance companies.

It is therefore not difficult to see that a participating policy-holder in a well established life office becomes the inheritor of sources of profit which have been accumulated in the past. For the most part these accumulations have been made without any injustice having been done to previous policy-holders, and it is owing principally to these past accumulations, to the past prosperity which present policy-holders have had little or no share in creating, that such good results can now be obtained, accompanied, be it always remembered, by the most complete security.

There is practically no limit to the adaptability of life assurance to innumerable different circumstances. Adequate knowledge of the most effective way of meeting particular requirements can only come from intimate acquaintance with the policies, the financial status, and the bonus prospects, of all the life offices in the country; but when such knowledge is available the beneficial results that are obtainable are little short of amazing, and are absolutely unapproachable by safe investments of any other kind.

Annual Investments Yielding Income.

The last example we have considered provides for the return of the capital invested after a number of years. It is also possible to make annual investments, which, in addition

to providing a large measure of insurance protection, yield immediate income upon the sums annually invested.

The next Table shows the results of investing £100 a year for 10, 15, and 20 years respectively.

RESULTS OF SAVING £100 A YEAR IN VARIOUS WAYS, PROVIDING IMMEDIATE INCOME AND INSURANCE PROTECTION.

Age 40 at commencement.

Years in force.	Cash at death.	Total sum invested.	The annual income.	Income % of sum invested.
	£	£	£ s.	£ s.
1	1,000	100	3 6	3 6
2	1,000	200	6 13	3 6
3	1,000	300	10 1	3 7
4	1,000	400	13 10	3 7
5	1,000	500	16 19	3 8
6	1,000	600	20 10	3 8
7	1,000	700	24 3	3 9
8	1,000	800	27 16	3 9
9	1,000	900	31 11	3 10
10 (and thereafter till death)	1,000	1,000	35 7	3 11
1	1,500	100	2 18	2 18
15 (and thereafter till death)	1,500	1,500	49 0	3 5
1	2,000	100	2 5	2 5
20 (and thereafter till death)	2,000	2,000	55 14	2 16

It will be seen that after paying £100 an immediate income of £3 6s. is received; at the end of the two years the income is £6 13s., and so it goes on increasing, until after ten years, when £1,000 has been paid the income is over £35 a year, which remains uniform for the rest of life, and the £1,000 invested is repaid at death to the estate of the investor. In the event of death during the first year, after only £100 has been paid, as much as £1,000 will be paid to the beneficiaries.

If this system of saving £100 a year is extended to 15 or 20 years, the income obtainable is smaller, but the amount of insurance protection is greater.

The next Table shows a slightly different application of a similar method. The income received is smaller than under the system just described, but, after the payment of premiums ceases, the amount of the policy increases by bonus additions, so that in the event of the investor living to an advanced age, the increase in the capital value of the investment is very large.

RESULTS OF SAVING £100 A YEAR IN VARIOUS WAYS, PROVIDING IMMEDIATE INCOME AND INCREASING INSURANCE PROTECTION.

Age 40 at Commencement.

Years in Force.	Cash at Death.	Total Sum Invested.	The Annual Income.	Income Per Cent. of Sum Invested.
	£	£	£ s.	£ s.
1	867	100	2 14	2 14
10	1,020	1,000	29 2	2 18
20	1,190	1,000	29 2	2 18
30	1,360	1,000	29 2	2 18
40	1,530	1,000	29 2	2 18
1	1,173	100	2 13	2 13
15	1,495	1,500	44 12	2 19
20	1,610	1,500	44 12	2 19
30	1,840	1,500	44 12	2 19
40	2,070	1,500	44 12	2 19

After the payments of £100 a year cease, the income remains uniform for life, but the sum assured continues to increase till death.

As another instance of the great adaptability of life assurance to different circumstances we may consider yet another system of saving £100 a year. In this case the sum assured is paid by instalments extending over twenty years, with the result that the income during life is exceptionally large, and the income for twenty years after death, whether the investor dies soon or lives long, is also very substantial. (See Table, p. 414.)

For instance, an investor saving £100 a year for ten years receives during his life an income at the rate of 4¼ to 4½ per cent. upon the amounts invested, while whenever he dies, even if it be immediately after the payment of the first £100, he leaves behind him an income for twenty years of £45 a year.

Such systems may be modified so as to yield a larger income during life and a smaller income after death, or *vice-versâ*.

When we consider that life assurance is capable of producing such results as these, it is difficult to imagine circumstances under which life assurance is not of advantage, or to invent excuses for abstaining from the benefits which it confers.

INSURANCE AND CHARITY.

I only propose to detain you with one further illustration of the advantageous application of life assurance, namely, as a means of benefitting hospitals and other charities. This, however, is a use of assurance which is capable

Results of Saving £100 a Year in various ways, providing Income for Life and for 20 Years after Death. Age 40 at Commencement.

Years in force.	Total sum invested.	Annual income in life.	Income per cent. of sum invested.	Income for 20 years after death. Amount.	Per cent. of sum invested.
£	£	£ s.	£ s.	£ s.	£ s.
1	100	4 5	4 5	45 0	45 0
10 (and thereafter till death)	1,000	45 0	4 10	45 0	4 10
1	100	2 18	2 18	100 0	100 0
15 (and thereafter till death)	1,500	48 15	3 5	100 0	6 13
1	100	3 14	3 14	90 0	90 0
20 (and thereafter till death)	2,000	87 0	4 7	90 0	4 10

of doing so much good, and which is so little recognised, I might say, so utterly unrecognised, that I feel justified in making a further demand upon your patience while I show the results it is possible to obtain.

It is almost true to assert that a substantial donation can be made to a hospital without loss of either capital or income. Consider, for instance, the following Table :—

Donations without Loss of either Capital or Income.

If your Age is	40	50	60
	£	£	£
You give Hospital ..	1,000	1,000	1,000
You pay Life Office	9,230	11,690	19,000
When you die the Life Office pays	10,230	12,690	20,000
While you live the Life Office pays you each year	307	381	600

If you are content with an absolutely safe investment yielding 3 per cent. upon your capital, you can, at age 40, give £1,000 to a hospital at once, receive 3 per cent. upon your invested capital (including the donation of £1,000) so long as you live, and have the entire capital invested in this way repaid at your death. Even after making this large donation to a hospital you have a better investment than is yielded by Consols or some other gilt-edged securities. Of course if the donation were not given to the hospital the return would be $3\frac{3}{4}$ per cent. or more, in place of the 3 per cent. you obtain under the system shown in the Table. The method is simply this, taking age 40 for example, You give the hospital £1,000; you pay £4,168 as a single premium to assure £10,230 at death, and you pay £5,062 to buy an annuity of £307 a year as long as you live. These three payments absorb £10,230, yield you an income of £307 a year, which is at the rate of 3 per cent. per annum upon your total outlay, and provide for the repayment of the whole £10,230 to your estate when you die. You obtain an absolutely safe 3 per cent. investment, and do not diminish your capital by a single penny in spite of the fact that you have given the hospital £1,000.

I have used donations to a hospital as an illustration because there is a practical unanimity of opinion that hospitals are deserving of support, and that the need for such support is exceptionally great and pressing. But this method, or the methods which I am about to describe, can equally well be used for the support of charities of other kinds, or as a means of raising money for more personal purposes without, in one sense, the loss of either capital or income.

Another method shows how an immediate donation may be made to a hospital, without any loss of income during the lifetime of the donor, or for twenty years after his death. The next Table illustrates this plan. If your age is 60 you can give £1,000 to a hospital, and you can pay £1,554 to a life office, or rather to two different life offices, so as to produce an income of £77 a year for yourself so long as you live, and an income of £77 a year for your beneficiaries for twenty years after your death. This yields during your own life, and for twenty years thereafter, an income at the rate of 3 per cent. per annum upon the whole £2,554

which you have paid away. You will recognise that this is only another application of a method of using life assurance as investment, which has been previously described.

DONATIONS WITHOUT LOSS OF INCOME.

If your Age is	40	50	60
	£	£	£
You give Hospital	1,000	1,000	1,000
You pay Life Office....	2,107	1,888	1,544
The Life Office pays each year while you live, and for 20 years after your death	93	87	77

If it is sufficient to provide an income only during your own lifetime a similar result can be produced at age 60 by the investment of a much smaller sum. This is illustrated in the next Table.

DONATIONS WITHOUT LOSS OF INCOME.

If your Age is........	40	50	60	70
	£	£	£	£
You give Hospital	1,000	1,000	1,000	1,000
You pay Life Office ..	980	744	490	304
The total you pay is ..	1,980	1,744	1,490	1,304
While you live the Life Office pays you each year	60	52	45	39

You can give a hospital £1,000, you can pay a life office £490 for an annuity of £45 a year, which will yield an income at the rate of three per cent. per annum upon the £1,490 which you have paid away. This really means that you can give a hospital an immediate donation of £1,000, instead of leaving it a legacy of £1,490. Very frequently such an immediate donation would be of a more value than a deferred legacy of a larger amount; and the donor would have the satisfaction of helping to control the expenditure of his donation.

In the last two systems described an increase in the total amount invested would yield the donor an income during life, at a higher rate than three per cent., and, in the first system, for 20 years after death, in addition.

It would often be advantageous to a hospital to substitute an immediate donation for an annual subscription, and the next Table shows how this result may be accomplished.

DONATIONS WITHOUT LOSS OF CAPITAL.

If your Age is	30	40	50	60
£	£	£	£	£
You give Hospital ..	1,000	1,000	1,000	1,000
You pay Life Office	503	688	1,019	1,639
The Life Office pays your estate at death	1,503	1,688	2,019	2,639

A man aged 40 could give a hospital £1,000, and could pay a life office £688 to assure the repaymeut of £1,688 when he died. So that, practically, he can substitute an immediate donation of £1,000 for, if we reckon three per cent. upon the total amount invested, a subscription of £50 a year.

There are various ways in which hospitals might, with advantage, make use of life assurance to provide contributions in the future. It is possible, for instance, for a man of fifty, by investing £1,000 now to secure a payment of £1,000 to a hospital at the end of twenty years, or at the death of the donor if it occurs previously; in addition to this he can himself receive an income of £30 a year for twenty years, and of £40 a year thereafter for the rest of his life. In fact there is no limit to the adaptability of life assurance to the purposes of charity. So far as I am aware it has never been applied to this purpose, and I feel sure that the Committees of Hospitals and other charities would do well to consider such applications of life assurance as I have already suggested, and such other suggestions as could be made by anyone intimately acquainted with the subject.

But it is time for me to stop. With the utmost sincerity I desire to acknowledge the honour that has been conferred upon me in being allowed to introduce a discussion upon life assurance before the Society of Arts for the first time. Perhaps even my inadequate arguments in its favour have shown some of the unique advantages which it provides. Whether we regard it as an illustration of progress in general, whether we look upon it as an advantageous application of natural laws which, when working in other spheres, fill us with wonderment and admiration; or whether we regard the great practical advantages which it offers us, life assurance must be looked upon as a system of surpassing value, not only to isolated individuals, but to the community at large.

The details necessary for the formation of a sane judgment on the subject are often con-

sidered dull and prosaic in the extreme. I have myself been guilty of publishing perhaps more statistics on the subject than any of my contemporaries; but believe me it is only necessary to bring a little imagination to bear upon Tables of figures and ratios to convert them into a fascinating romance. Professor Tyndall has urged upon us the need of imagination in Science; I would urge upon you the necessity, the attractiveness, of the use of imagination in Insurance. Imagination, not to twist statistics, or to disguise the meaning of facts, but to shed upon them a light that will exhibit their full significance, that will bring out the beneficence of their operations, and reveal the advantages which life assurance at present confers, and which, in far fuller measure than now, it will confer in the future.

DISCUSSION.

The CHAIRMAN said the paper seemed to him to be admirable as a survey of the history and the present position of the various forms of assurance, and their adaptation to particular needs of social life, and what was always, to his mind, of greater value than any merely historical or expository statement of a subject, and furnished a true test of permanency of value, the paper was also excellently suggestive in the manner with which it dealt with the various aspects of the case. He thought that the analogies, which Mr. Schooling had exhibited, with the activities of animal life and their adaptations, furnished more than mere illustrations. For all connected organic systems of work were naturally only competent of continued existence if they possessed the flexible readiness and the inherent aptitude to adapt themselves to the necessarily changing conditions of a complex social state in the midst of which they maintained their being, and with which, if they were to avoid extinction, they had adequately to conform. Indeed, as an example, many insurance companies, of great importance and reputation in their day, had finally disappeared from independent existence by absorption into other more progressive societies, in consequence of having forfeited their right to their natural station in industrial life either by reason of adhering to old and stereotyped manners of business, or else by inertness and rigidity of management. He would deal for a moment with one of the many forms of modern assurance which had risen to pronounced eminence only within the last few years, viz., the endowment insurance scheme, which provided payment of the sum assured on the attainment of a specified age or at previous death. Looking to the essentially prudential character of life assurance he deplored most sincerely that decisive change in popular choice. If, as was natural, an assured desired a cessation of premiums when the period of practical retirement from active life had arrived, he could yet retain the ancient prudential form of policy by assuring for the whole period of life; but, by a slightly augmented increase of premiums, he could provide for their termination at any specified age. At the present time the extent of that popular diversion of selection was indicated by the fact that, in the entire new business transacted each year by the whole of the companies, from 50 to 80 per cent. of the new policies consisted exclusively of endowment assurances, while, within his remembrance not so very far remote, practically the whole of the policies completed partook simply of the whole-life type. Bearing in mind the analogies which Mr. Schooling had presented, it was interesting to trace the apparent origin of that change in popular selection. The question of old age pensions had been discussed during the past few years, not only with vehemence but with persistent industry, and the schemes which had been propounded for its solution had possessed every possible merit except that of practicability. It was undoubtedly to that agitation that the increase of endowment assurance business at the present time could be assigned. For policies of that kind, by making the sum assured payable at a definite epoch in the assured's lifetime, did naturally provide a pension or annuity not merely in the shape of the negative annuity involved in the cessation of premiums, but in the positive annuity presented by the investment of the sum assured and the income which was derived. That curious and indirect result from the discussion of old age pensions no one could have anticipated,—a result materially affecting the whole future history of life assurance, both as regards the type of its chief description of business, the quality of lives it selected, and above all, and significantly, the rate of expenditure and its bearing upon profits. For if the present energy of competition continued—and unfortunately, he perceived no probability of its abatement—increasingly larger expenditure must be incurred for the purpose of supplying the heavy periodical loss of business produced by the successive maturity of those policies, and consequently, even on that ground alone, the rate of profit in life assurance must steadily diminish. That indirect result of a discussion of a totally different subject formed a most instructive and interesting comment upon the doctrine of the French economist, Bastiat, that in all political, social, or economic questions the things that are unseen, as possible results, require to be forecast and measured even more sedulously than those consequences which are evident and apparent. He felt greatly indebted to the author for the suggestions the paper offered for reflection upon a great and increasing social question like that of life assurance.

Mr. C. H. E. REA very much appreciated the labour which had evidently been expended upon the production of the paper, and thought the diagrams

developed a good many new features. The paper was a curious one, inasmuch as it seemed to be a combination of astronomical, terrestrial, biological, and botanical subjects, all mixed up. As to whether the colliding of celestial bodies would generate more heat in the future, that seemed to have some bearing upon fire insurance, about which he knew very little. There were a great many new features in connection with life assurance to be studied. In some of their institutions they had come to the conclusion that they had arrived at a sort of *ne plus ultra*, and they had certain formulæ and certain conclusions from which there could be no departure. But every day new developments came about, and he was not at all sure that they would not have another movement, and go back from complexity to simplicity. The original object of life assurance was to protect the widow and children from the grave circumstances attending the husband and father dying, and he thought that was the primary feature which should be the most encouraged. We were inclined nowadays to get too much of the commercial element embodied in our insurance contracts. He would like every encouragement to be given to the development of life assurance pure and simple, and in that respect he entirely agreed with the remarks of their distinguished Chairman when he deplored the pressure brought to bear on the development of endowment policies. This country was inclined to be extremely conservative in all matters. The members of the Society of Arts must be more conversant with artistic matters than he, but it must be generally recognised that in the development of music innovations were more slowly accepted in this country than perhaps any other. When the music of Wagner and all such great musicians was first heard in this country, it was the subject of pantomime and ridicule on all hands. The same thing might be said with regard to art and painting. Turner's works were once regarded as daubs and mere rubbish, and it was very long before their value began to be recognised. So it is with life assurance; we are very slow to adopt any new features. He was surprised that Mr. Schooling had not made some reference to the feature which was extending so rapidly across the Atlantic; he was not referring to the assessment societies, because he disapproved of their principles entirely, but to the work done by some of the fraternal Orders. Those Orders conducted their business on a level premium basis, but as they did it through their own Courts, and without the necessity for the heavy expenditure to whch Mr. Schooling had referred, which absorbed, in many cases, the entire first year's premium, they were able to afford pure life assurance protection to the widows and children at a minimum of cost. As a fact, their first year's premium was the largest they received, because members had to pay entrance fees. That was a new feature which was apparently developing itself pretty rapidly in this country. Of course the lapse rate was great in nearly all companies, but in connection with ordinary insurance policies it was at the highest point during the first year, and gradually diminished, and so it was with the fraternal Orders. But with the latter case it did not affect them because there was no return of premium, and there was no initial cost to the Society. They got a large premium the first year which was not expended outside, but in the ordinary companies that had gone, and the lapse rate was of considerable importance to them. As to the illlustrations which Mr. Schooling had given showing how one could give away £1,000 and get it back and have something more, and his reference to a bird in the hand, he wished he had some of those birds, they would be rather useful sometimes. He was disposed to think that pension schemes would arise through the influence of some fraternal organisations, and he thought that was the only possible solution to such schemes in this country.

Mr. J. H. HARRISON HOGGE said that he had been very much impressed with the ideas put forward in the paper, but when he heard the Chairman and Mr. Rea deprecate the endowment assurance policies he failed to grasp that idea because he thought the time had now come when the old-fashioned policy was a thing of the past, and that they had to look forward to giving the British public more for their money than mere insurance protection in the way of providing for those whom they might leave behind. There were many possibilities, such as all a man's people going first, and his old age having to be provided for; if there were no endowment assurance, what could he do with a whole life policy? He saw a possibility of touching a class of people who otherwise would not be touched at all, viz., the moneyed class. If one went to that class they said at once, "What do I want insurance for?" and unless one could show them something in the form of an investment, as seen in some of the diagrams, there was really no argument to put before them. Mr. Schooling had mentioned the Tontine bonus. He (Mr. Hogge) saw its advantages and its disadvantages, and thought anyone would be foolish who contemplated taking a Tontine bonus, whereby should he die before it had accrued he would make a loss. But by a modification, by adding what was called a progressive bonus, that could always be avoided, and he would always insure a good return to his estate. Therefore, by living an allotted number of years, he would get a larger return on his money than if an annual bonus were declared. The whole benefit of a Tontine bonus was, that if insurance was no longer necessary when that bonus was declared, certain options were given whereby that which had protected a man's estate in the past, would then be available for himself if he so desired it, and he wished to terminate the contract. With reference to annual income, if one took a man to-day, who had £2,000 invested in railway securities, which was bringing him in £60 a year, he could not afford any

insurance, because that was all he had to live on; but if he sold out those securities, £100 each year, with that £100 he could by Mr. Schooling's illustration, not only secure his 3 per cent. interest just the same, but he would buy insurance protection for the difference. His income would be exactly the same, but in the event of his death he would leave £1,900 capital, during the first year, with the railway company, and would leave, roughly speaking, £1,500 in the insurance investment, so that it would mean a large return to his estate. That would occur proportionately the whole way through the fifteen years, and at the end of the time he would be in the same position as he was originally. Another point he would mention with regard to investment assurances was the great possibilities of the single premium policies. There were many of the moneyed class, especially Stock Exchange men, who often made money quickly, and if they could be induced to pay a single premium, for instance £400 for £1,000, then if a bad time came it was always realisable, and the surrender value was large. Mr. Schooling had not given much information on the question of surrender values, which was a very great point. It was all very well for a man to invest in the different schemes mentioned, but if he had to realise it, it would be well to know what his position would then be.

Mr. E. T. SCAMMELL did not quite know whether they had been listening to the scientific advocate of assurance only, or the poet, philosopher, naturalist, and a number of other excellences in one. Mr. Schooling had himself given an illustration of the advantages of that imagination applied to insurance, with which he had concluded his paper. The subject had been presented in a most attractive and fascinating way. He had wondered at first what in the world the stars and the nebulæ had to do with insurance, but Mr. Schooling had made it very plain indeed. He had worked out a simple scheme of evolution and shown how those great principles applied, even to life insurance. His reference to the endowment assurance schemes and the discussion which had taken place upon it was further most enlightening, and Mr. Rea's remarks with regard to fraternal insurance were very interesting. Mr. Rea had spoken of Mr. Schooling talking about the stars and all the rest of it, but he had himself wandered a little to give an illustration from art—very well done—and then said that, after all, we should perhaps go back from the complex to the simple. Mr. Rea had, however, shown that we ought not to do so, because we should be prepared to accept the new ideas which were coming in; that was more likely to make the complex still more complicated. No doubt insurance men would keep their minds open to all kinds of new ideas, from America, Canada, or any part of the world, and would seek to have, with simplicity, that complexity which would mean the adaptation of insurance to all the needs that might arise. That, he believed, was Mr. Schooling's main point. Given any particular need or variety of circumstance, the author wanted to show how life assurance might be made applicable to any such differentiation of circumstances, and he had made it exceedingly clear. He was glad that Mr. Hogge had come to the conclusion that there was a very great deal in what Mr. Schooling had said with regard to the various new aspects of insurance. As an old member of the Society of Arts, he was pleased that it had taken the opportunity of having a paper on insurance, the treatment of which had been extremely interesting and instructive.

The CHAIRMAN proposed a hearty vote of thanks to the author for the opportunity he had given them of surveying the great field of inquiry and also accomplishment which the subject of life assurance involved.

Mr. SCHOOLING thanked the members for the vote and the proceedings terminated.

Miscellaneous.

THE SUNFLOWER AS A PREVENTIVE OF MALARIA.

The following notes on the sanitary effects of sunflower cultivation are taken from an article by Mr. Edward Gould in the *Gold Field News and Barberton Herald*:—

Evidence regarding sunflower cultivation in malarial districts has come to me from different quarters. Some years ago, previous to the war in the Transvaal, I read in an American work the future solution of destroying malaria as tried in the most affected districts of Central America.

In former years, whilst tobacco farming around Barberton, I have made several attempts to determine for my own satisfaction and health's sake if there was any bottom to the theory about malarial germs being destroyed by sunflower cultivation on an extensive scale.

I could not bring any satisfactory termination to my experiments in isolated positions for the want of comparisons, nor could I learn anything through the many enquiries I made in favour of the cure advanced from the other side of the Atlantic.

Not until 1886, whilst actually residing in Delagoa Bay, could I help to substantiate that sunflowers were a preventive of Delagoa fever. A double row was planted around the fence and every vacant corner was filled on a double stand on which I resided with my family. That season we were all free from Delagoa Bay fever.

A few days back chance brought me in touch with

a man who had settled down in De Kaap Valley, but who had formerly resided for many years in the Mississippi Valley, in the Southern part of the United States. From him I learned conclusively of the enormous value of sunflower cultivation throughout all the malarial districts of both North and South America. "Years ago," he informed me, "the Mississippi Valley was one of the most unhealthy valleys for yellow fever of all the low-lying districts of the Southern States. Men had ague every other day, they saturated themselves with quinine. The residents along the river banks were conspicuous for their ghastly yellow looks, far worse than anything seen in Delagoa Bay in the worst season. The Mississippi River at certain seasons overflows, bringing down masses of black miasmic mud, depositing the same on the banks; then everybody goes down with yellow fever, which it is impossible to shake off. At last the cultivation of sunflowers was adopted by law, with the result that the fever has been gradually conquered, and is now a scourge of the past. Owing to the profitable nature of sunflower cultivation, immense paper mills have sprung up, utilising the fibre, &c., for many trade purposes."

The sunflower plant comes originally from Mexico; its reputation is world wide. Its cultivation when grown on a large scale is much the same as mealies. By planting 5 lbs. weight of seed to the acre—broad cast or ridge—18 cwt. of good clean seed will return in four months, with ordinary cultivation on average land. From this 300 lbs. of oil can be pressed, or 18 per cent. of the weight harvested.

On average land the crop is 50 bushels to the acre, averaging one gallon of oil to each bushel yielded. In the fertile valleys around Barberton, from 15 to 20 per cent. can be added. Samples of seed-crowns I exhibited in Barberton in 1894 measured 21 inches across.

The oil yielded from the ripe sunflower seeds is of great commercial value, it is superior to olive and almond oils for table use, for frying fish it is unequalled. For burning in lamps it lasts longer and gives a brighter light than any oil. For paintings (greens and blues) it is the most brilliant. In high-class scented soaps it is most valuable on account of softness. It makes the best wax candles. As a drying oil it is equal to linseed. It is the best-known oil as a lubricant. A farmer can increase his income from £50 to £100 a year by growing sunflowers in every odd nook and corner and keeping bees. Here again it supplies the wax. The yellow flower is a fast dye. In manufacturing the most expensive woollen cloths, sunflower oil establishes the finest gloss.

The stalk produces fibre as fine as silk and as coarse as flax, as required, in large quantities. Since rags have become scarce, the fibre is used for paper-making. When the oil is extracted from the best seeds, the residue, together with the 80 per cent. above-mentioned, is again crushed into a mash or oil-cake, which sheep, pigs, pigeons, rabbits, poultry, and horses will fatten on rapidly. The green leaves when ripe make a fine fodder, if mixed with bran, for cows. Feeding fowls on bruised sunflower seed is said to increase their laying powers. The pith is used by surgeons, also the oil for demulcent and soothing purposes.

In *Tropical Cultivation*, Ceylon, 1889, we read: "In swampy places where intermittent fevers are common, the cultivation of sunflowers on a large scale has been found effectual in remedying, and in some cases altogether destroying, the fevers peculiar to marshy districts in tropical climes."

The warm, sheltered, sub-tropical climate of De Kaap Valley, with its much maligned malarial reputation, is a most suitable field for this neglected produce of the very first commercial importance to the Government, the people, and the country.

ITALIAN SILKWORMS.

Silkworms bred in Italy are exclusively those which feed on the mulberry leaf, so that the "yama-mai," and the "eri," and the "muga" have no place on the Italian market. The breeds cultivated in Italy are (1) the pure yellow, which is the old race of the country. This uncrossed breed forms a large part of the national production. (2.) The white indigenous, cultivated only to a limited extent; and (3) the Japanese cross, produced from the pure yellow moth and the moth of the green Japanese breed. The worms of this cross are extremely robust, and the cocoons are abundant and generally reliable. The produce is considered of less value than the pure yellow, but forms an important part of the national culture. Consul Jarvis, of Milan, states that the Chinese cross is produced with the pure yellow moth and the white (spherical cocoon) Chinese moth. This cross makes a smaller cocoon, which is consequently of less weight than the pure yellow, but is equal to it in comparative value. No public office exists for testing and sorting eggs. The seller who supplies eggs which do not give satisfaction loses his customers. There is no fixed rule in regard to planting mulberry trees. Thousands of square miles of these trees are planted in rectangles, the average distance from each other being nine yards by seventeen yards, thus forming avenues seventeen yards broad with the trees in lines nine yards apart. Trees can be planted either in spring or autumn, and can be transplanted. If in good condition they live from 50 to 70 years. Ordinary trees under usual conditions will produce from about 35 to 65 pounds of leaves in a year. The price obtained for fresh and good cocoons is from three to three and a half lire (2s. 5d. to 2s. 9d.) per kilogramme (2·2 pounds avoirpupois), according to locality and to quality of eggs. Dry cocoons fetch about 10 lire (8s.) per kilogramme, but with the guarantee that 4 kilogrammes (8·8 pounds) of cocoons will yield 1 kilogramme (2·2 pounds) of silk.

Correspondence.

PROTECTION FROM FIRE.

Colonel Fox, in his remarks on the test of "fire-resisting materials" in the discussion of Mr. Brice Phillips's paper on Wednesday last, did not refer to the tests made by the British Fire Prevention Committee, of oak or teak, or of Jarrah and Karri, to which I had referred, but to timbers that had been rendered "non-inflammable" by treatment.

My statement in regard to the results of the fire in Victoria Docks, and to the evidence afforded of the fire-resisting quality of Jarrah, was based upon my inspection of the stacks of timber, after the fire, and upon the report of the Sub-committee of the British Fir Prevention Committee (December, 1902), who said, "At the north-eastern end of the yard, and about 36 feet away from the shed, was a pile of Jarrah wood some 30 to 40 feet high, and having a frontage to the shed of about 36 feet, and to the basin of about 100 feet. Projecting in front of this pile of Jarrah wood for about 10 feet, and abutting upon it, on the shed and basin sides, were piles of deal about three-quarter the height of the Jarrah stack, and these were very largely consumed by the fire, the flames from which played on to the pile of Jarrah, generating considerable heat; but though the Jarrah bore the brunt of the fire, as what wind there was blew in this direction, comparatively little damage was done to this pile, and this was confined to the north and west faces, the fire failing to penetrate far into the interior. Your Sub-committee are of opinion that, but for the resistance offered to the fire by this stack of Jarrah, the conflagration would have assumed much larger proportions, as in the rear and on the south side were large quantities of deals, and, had they ignited, the task of the fire brigades would have been far larger and more difficult." The report further stated that "the wooden sides of the railway trucks between these piles (deal) and the shed, were entirely consumed, only the ironwork and the decking remaining, leaving the Jarrah wood paving blocks (which were in the trucks) intact, but for charring on the face of the outside blocks directly exposed to the fire."

The Street, commenting on this fire in its issues of October and November, 1902, said "There can be little doubt that if the timber in the mill and in the yard had consisted wholly of Australian hard wood, instead of deals and hard wood in juxtaposition, the fire would not have made much headway before being mastered by the brigades and the dock companies floating engines. After all, an actual fire is the best fire test, even though an expensive one for the moment."

E. T. SCAMMELL.

March 16th, 1903.

THE LIBRARY.

The following books have been presented to th Library since the last announcement:—

Argentine Year Book. 1902. Buenos Aires: Joh Grant and Son. Presented by Ernest Danver Esq.

Atkins, H. G., M.A.—A Skeleton French Grammar A Skeleton German Grammar. London: Black and Son, Ltd. 1902. Presented by the Pu lishers.

Bisiker, W.—Across Iceland. London: Edwa Arnold. 1902. Presented by the Author.

Black, Clementina.—Frederick Walker. London Duckworth and Co. Presented by the Publishers

Black, William, L.R.C.S.E.—Narrative of Cruis in the Mediterranean during the Greek War Independence, 1822-1826. Edinburgh: Oliver ar Bond. 1900.

Black, W. T., M.R.C.S.—The Fish River Bus South Africa, and its Wild Animals. Edinburgh Y. J. Pentland. 1901. Presented by the Autho

Bourroul, Estevam L.—Hercules Florence, 1804-187 S. Paulo. 1901. Presented by Senor José Campos Novaes.

Bréal, Auguste.—Rembrandt: A Critical Essa London: Duckworth and Co. 1902. Presente by the Publishers.

Brebner, C. W.—New Handbook for the India Ocean. Bombay. 1898. Presented by th Author.

Bright, E. B., and Charles Bright, F.R.S.E.—Th Life Story of the late Sir Charles Tilston Brigh 2 Vols. Westminster: Constable and Co. Pre sented by Charles Bright, Esq.

Carroll, John.—Pattern Drawing and Desig London: Burns and Oates, Ltd. 1902. Presente by the Publishers.

Charpentier, Paul.—Timber: A Comprehensive Stud of Wood in all its Aspects. Translated from th French by Joseph Kennell. London: Scot Greenwood and Co. 1902. Presented by th Publishers.

Cockerell, Douglas.—Bookbinding and the Care Books: A Text-Book for Bookbinders an Librarians. London: John Hogg. 1901. Pre sented by the Publisher.

Coghlan, T. A.—New South Wales Statistic Register for 1900; The Wealth and Progress o New South Wales, 1900-1901. Sydney: W. A Gullick. 1902. Presented by the Agent-Genera for New South Wales.

Coventry, W. B.—A History of Pont-y-ty-Pridd, wit an Investigation of the Stability of the Arch. London Sands and Co. 1901. Presented by the Author.

Crosskey, L. R., and James Thaw.—Advance Perspective. London: Blackie and Son, Ltd 1901. Presented by the Publishers.

Davison, Charles, D.Sc.—Easy Mathematical Problem Papers. London: Blackie and Son, Ltd. 1902. Presented by the Publishers.

Doman, W.—The Production and Use of Acetylene Gas. London: P. S. King and Son. 1902. Presented by the Publishers.

Eckenstein, Lina.—Albrecht Dürer. London: Duckworth and Co. Presented by the Publishers.

Eissler, M.—The Hydro-Metallurgy of Copper. London: Crosby Lockwood and Son. 1902. Presented by the Publishers.

Francis, Major Grant, F.S.A.—The Smelting of Copper in the Swansea District, from the Time of Elizabeth to the Present Day. Swansea. 1867. Presented by Arthur Luty, Esq.

German Empire of To-Day, by "Veritas." London: Longmans, Green and Co. 1902. Presented by the Publishers.

Godman, Dr. F. D.—The Godman Collection of Oriental and Spanish Pottery and Glass, 1865-1900. London. 1901. Presented by the Author.

Grierson, W.—Practical Book-Keeping for Commercial Classes. London: Blackie and Son, Ltd. 1902. Presented by the Publishers.

Harmony of the Empire, being a Series of Sketches in Pictorial Geography of the British Possessions, by the Author of "The Making of Europe." Manchester: Abel Heywood and Son. 1901. Presented by the Publishers.

Harrison, W. J., F.G.S.—Junior Chemistry and Physics. London: Blackie and Son, Ltd. 1902. Presented by the Publishers.

Hueffer, F. M.—Rossetti: A Critical Essay on His Art. London: Duckworth and Co. Presented by the Publishers.

Iyengar, S. V. Ramaswamy, M.D.—The Influence of Age and Study on Eyesight in General and Myopia in Particular. Bangalore. 1902.

Kirkby, Wm.—The Evolution of Artificial Mineral Waters. Manchester: Jewsbury and Brown. 1902. Presented by the Publishers.

London Statistics. 1900-1901. Presented by the London County Council.

Mackay, D., M.A., and F. J. Curtis, Ph.D.—First French Book, according to the "New" Method of Teaching Modern Languages. 2nd Edition. London: Whittaker and Co. 1901. Presented by the Publishers.

Mardon, H. W.—A Geography of Egypt and the Anglo-Egyptian Sudan. London: Blackie and Son, Ltd. 1902. Presented by the Publishers.

Mascarenhas, J. C., F.C.S.—A New English and Portuguese Grammar and Commercial Handbook. London: Hirschfeld Bros. 1901. Presented by the Author.

Mélard, A.—Insufficiency of the World's Timber Supply. Translated from the French by F. Gleadow. Allahabad. 1901. Presented by the Translator.

Meunier, L. B.—A New Practical Method of Learning French Colloquially. Liverpool: Philip, Son and Nephew. Presented by the Author.

Norris, W. and B. H. Morgan.—High-Speed Steam Engines. London: P. S. King and Son. 1902. Presented by the Publishers.

Novaes, José de Campos.—As Origens Chaldeanas do Judaismo. Sao Paulo, Brazil. 1899. Presented by the Author.

————. Cryptogamos Microscopicos das Videiras. Campinas. 1899. Presented by the Author.

Perry, A. Latham, D.D., LL.D.—Miscellanies. Williamstown, Mass. 1902. Presented by the Author.

Pezet, F. A.—The Question of the Pacific. An Edition in English of the Work of Dr. V. M. Maurtua. Philadelphia. 1901. Presented by the Author.

Piper, C. W.—A First Book of the Lens. London: Hazell, Watson, and Viney, Ltd. 1901. Presented by the Publishers.

Poore, George V., M.D.—The Earth in relation to the Preservation and Destruction of Contagia. London: Longmans, Green and Co. 1902. Presented by the Publishers.

Rainfall Data of India, 1901. Published by the Meteorological Department of the Government of India. Calcutta. 1902. Presented by the Department.

Traill, W. H.—A Queenly Colony. Brisbane. 1901. Presented by the Agent-General for Queensland.

Turner, Fred., F.L.S.—Australian Grasses (Vol. I.). Sydney. 1895. Presented by the Author.

Van Ryn, Dr. J. J. L.—On the Composition of Dutch Butter. London: Baillière, Tindall and Cox. 1902. Presented by the Publishers.

Von Dadelszen, E. J.—New Zealand Official Year-Book, 1902. Wellington: J. Mackay. 1902. Presented by the Colonial Government.

Wanklyn, J. A., M.R.C.S. Arsenic. London: Kegan Paul, Trench and Co., Ltd. 1901. Presented by the Author.

Yate, Major A. C.—The Life of Lieut.-Colonel John Haughton. London: John Murray. 1900. Presented by the Author.

Year-Book of Australia for 1902. Presented by the Agent-General for New South Wales.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock:—

MARCH 25.—"Oil Lighting by Incandescence." By ARTHUR KITSON. PROFESSOR VIVIAN B. LEWES will preside.

APRIL 1.—"Application of Polyphase Motors to the Electrical Driving of Workshops and Factories." By ALFRED C. EBORALL, M.I.E.E. PROFESSOR JOHN PERRY, F.R.S., will preside.

APRIL 22.—"Modern Bee-Keeping." By WALTER FRANCIS REID, F.C.S.

Dates to be hereafter announced:—

"Preservation of the Species of Big Game in Africa." By E. NORTH BUXTON.

"Fencing as an Art and an Historic Sport." By EGERTON CASTLE, M.A.

"Automatic Wagon Couplings on British Railways." By F. A. BROCKELBANK.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock:—

APRIL 23.—"The Province of Sind." By HERBERT MILLS BIRDWOOD, C.S.I., M.A., LL.D. The EARL OF LYTTON will preside.

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D. The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M.P., will preside.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 or 5 o'clock:—

MARCH 31, at 4.30 p.m.—"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo. The RIGHT HON. SIR GEORGE TAUBMAN GOLDIE, K.C.M.G., will preside.

MAY 5, at 4.30 p.m.—"The Lagos Hinterland: its People and its Products." By MAJOR J. H. EWART.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock.

APRIL 28, 7.30 p.m.—Visit to the Whitefriars Glass Works. Paper by Mr. HARRY POWELL on "Modern Table Glass."

MAY 19, 4.30 p.m.—"Mezzotints." By CYRIL DAVENPORT, F.S.A. The process will be fully explained.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

PROF. J. A. FLEMING, M.A., D.Sc., F.R.S., "Hertzian Wave Telegraphy in Theory and Practice." Four Lectures.

LECTURE IV.—MARCH 23.—*Syntonization and possible Improvements.*—The problem of syntony—Time period of an electric circuit—Syntonic arrangements of Lodge, Marconi, Slaby, and others—The difficulties of the problem—Suggested substitute for syntony—Arrangements of Blondel and Anders Bull—Problems awaiting solution—The limitations and utilities of Hertzian wave telegraphy—The future of the new telegraphy.

W. WORBY BEAUMONT, Mem.Inst.C.E., "Mechanical Road Carriages." Four Lectures. April 27, May 4, 11, 18.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. J. A. Fleming, "Hertzian Wave Telegraphy in Theory and Practice." (Lecture IV.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. J. L. Crouch, "The Rating of Brickfields."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

East India Association, Westminster Palace Hotel, S.W., 4 p.m. Mr. J. D. Rees, "The Western Frontiers of India."

TUESDAY, MARCH 24...Aeronautical (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m. 1. Mr. John Anderson, "The Kite Equipment of the Scottish National Antarctic Expedition." 2. Mr. Patrick Y. Alexander, "The Aërosac," 3. Major L. S. Blackden, "Observations and Experiments relative to Equilibrium in Air of a Body Heavier than Air."

Royal Institution, Albemarle-street, W., 5 p.m. Sir Robert Ball, "Great Problems in Astronomy." (Lecture II.)

Medical and Chirurgical, 20, Hanover-sq., W., 8½ pm.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Amyas Morse, "The Protection Works of the Kaiser i-Hind bridge over the River Sutlej, near Ferozepur."

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. J. W. Lovibond, "The Photographic Value of Different Coloured Rays and their relation to White Light."

WEDNESDAY, MARCH 25...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Arthur Kitson, "Oil Light by Incandescence."

Geological, Burlington-house, W., 8 p.m.

Chemical, Burlington-house, W., 4½ p.m. Annual Meeting.

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, MARCH 26...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Lieut.-Col. W. A. Davidson, "A System of Local Guides for Home Defence."

Society for the Encouragement of Fine Arts, 6½, Suffolk-street, Pall-mall, S.W., 8 p.m. Sir Wyke Bayliss, "The Bogey in the Studio."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. C. H. Firth, "Society during the Commonwealth and Protectorate." (Lecture II.)

Electrical Engineers, 25, Gt. George-st., S.W., 8 p.m.

The Institution of Electrical Engineers, at the Institution of Civil Engineers, Great George-street, Westminster, S.W., 8 p.m. 1. Mr. A. D. Constable, "Distribution Losses in Electric Supply Systems." 2. Mr. E. Fawsett, "A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms."

FRIDAY, MARCH 27...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Prof. W. A. Herdman, "The Pearl Fisheries of Ceylon."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. J. G. Y. D. Morgan, "The advantages of Motor-driven Printing Machines."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

SATURDAY, MARCH 28...Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "Light: its Origin and Nature." (Lecture V.)

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FRIDAY, MARCH 27, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

TUESDAY, MARCH 31, 4.30 p.m. (Colonial Section.) HENRY WALKER, "British North Borneo."

WEDNESDAY, APRIL 1, 8 p.m. (Ordinary Meeting.) ALFRED C. EBORALL, "Application of Polyphase Motors to Electrical Driving of Workshops and Factories."

Further details of the Society's meetings will be found at the end of this number.

APPLIED ART SECTION.

Messrs. James Powell and Sons have kindly invited the Applied Art Section to visit the Whitefriars Glass Works, Tudor-street, E.C., on Tuesday evening, April 28th, from 7.30 to 10.30 p.m. A short paper, "On Modern Table Glass," will be read by MR. HARRY POWELL, and the processes will be explained in the glass-house.

The accommodation is strictly limited and 100 tickets only will be issued. These tickets will be issued in order of application to Members until the number is exhausted. Each Member is entitled to apply for one ticket, which will be transferable.

No one can be admitted without a ticket.

CANTOR LECTURES.

The fourth and last lecture of his course on "Hertzian Wave Telegraphy in Theory and Practice," was delivered by PROFESSOR FLEMING, M.A., D.S., F.R.S., on Monday evening, 23rd inst.

Sir FREDERICK BRAMWELL, Bart., D.C.L., F.R.S. (Chairman), moved a vote of thanks to the lecturer for his brilliant course of lectures.

The Lectures will be printed in the *Journal* during the summer recess.

Proceedings of the Society.

INDIAN SECTION.

Thursday, March 12, 1903; Sir EDWARD A. SASSOON, Bart., M.P., in the chair.

The paper read was—

THE CURRENCY POLICY OF INDIA.

BY J. BARR ROBERTSON.

India is naturally a country to which silver is better suited than gold for the purposes of money. The vast numbers of its population, and the very slender resources and income of all except a limited number, make it extremely desirable that its money should be of small denomination and intrinsic value, so that the people may be able to carry out with facility the vast mass of their transactions for very small amounts. For more than 60 years before 1899, silver had been the sole unlimited legal tender, and in the last 25 years, successive Indian administrations have supported the various efforts that have been made to establish a fixed par of exchange between gold and silver, by international agreement, though the particular terms contained in the proposal of the American and French Governments in 1897 were not approved of by the Indian Government of that day.

The failure of so many efforts, and the increasing divergence between the values of gold and silver, caused the Indian Government in 1892 to consider seriously their position in regard to the great fall in the rate of exchange, and the threatened further fall, and they came to the conclusion that the only policy that could arrest this downward course, was to close the mints to the silver of private owners. In order to calm the fears of a considerable body of objectors who thought it necessary to provide against the danger of a considerable rise in the exchange, they proposed to take in at the Indian treasuries any amount of gold that might be offered, and to give out rupees in exchange at the rate of one rupee for every 1s. 6d. worth of gold tendered. The committee, presided over by the late Lord Herschell, was appointed to investigate the proposals, and it finally reported

in favour of closing the mints and of issuing rupees for gold at one rupee for every 1s. 4d. instead of 1s. 6d. This policy was passed into law by the Indian Government on June 26th, 1893.

The closing of mints is clearly one of the prerogatives that Governments may rightfully exercise, the sole question in each case being whether it is wise or expedient to resort to it in any particular set of circumstances. The causes that led the Government of India to close the mints at the time they did, were clear and unmistakable. In the financial year 1872-3 the average rate at which Council Bills were sold was 1s. 10¾d., and the rate fell steadily for twenty years, so that in 1891-2 the rate was 1s. 4¾d., notwithstanding that purchases of silver by the United States had been, from 1878 to 1890, on the scale of the minimum fixed by the Bland and Allison Acts, namely, 2,000,000 dols. worth per month, and from 1890 to 1893, under the Sherman Act, at the rate of 4,500,000 ounces per month. At the end of 1893 these purchases were entirely abandoned, and silver was left to its fate.

Ever since 1873 the question of the fall in the gold price of silver, and consequently in the gold rate of exchange of the rupee, had been a cause of anxiety to the Indian Government and to merchants engaged in its external trade with this country and with other gold money countries. As gold appreciated and the rupee rate of exchange fell, more rupees were necessary for all classes of gold debts, and particularly was this conspicuous in connection with the Indian home charges. As compared with a rate of 2s. at which the accounts of the Government were kept, the loss by exchange for 1892 as shown in the remittances of the Indian Government reached Rx.9,946,200. The average rate for Council Bills which in 1891-2 had fallen to 1s. 4¾d., had further fallen in 1893 to a fraction less than 1s. 3d. The probable partial or total suspension of the purchases of silver by the United States, which was strongly advocated there, was in these circumstances a danger of very great magnitude hanging over the Indian financial position, because all efforts at an international settlement of a par of exchange between gold and silver had proved abortive, and there was no reasonable expectation of any such solution being arrived at in the near future.

In the meantime between 1873 and 1892 many proposals had been made to the Government to close the mints to the silver of private holders, but so long as the equilibrium of Indian finance was not seriously endangered, the Government had declined to close the mints. When, however, the rupee fell to 1s. 3d., with the likelihood that it might fall a great deal further, the Government felt that the limit of safety for Indian finance had been reached, and that the mints ought to be closed. No doubt this step was taken by the Indian Government with great reluctance, as it imposed on them a very grave responsibility. In the interest of India, however, the step was essential if greater evils were to be warded off than those that might be expected to follow in the train of the closed mints.

The increased purchases of silver by the United States under the Act of 1890 had raised the price of that metal, and the following figures of Mr. Sauerbeck's cover the years before and after the closing of the mints:—

Year.	Gold value of Silver in London. 100=60.84d. per oz.	45 Leading Commodities in London. 100=gold prices of 1867-77.
1889	70	72
1890	78	72
1891	74	72
1892	65	68
1893	59	68
1894	48	63
1895	49	62
1896	50	61
1897	45	62
1898	44	64
1899	45	68
1900	46	75
1901	45	70
1902	40	69

In spite, therefore, of the large purchases of silver by the United States, its gold value fell in 1892 to 65, and by 1894 it had fallen to 48. But in addition to the fall in the gold value of silver as a consequence of the appreciation of gold, a new factor came in to lower the gold value of the rupee, and that was the increased supplies of silver that were imported into India.

The yearly average of the net imports of silver in the 15 years, 1860-74, was Rx.7,920,388, whereas during the 15 years 1875-89, the yearly average was only Rx.6,503,575. Yet it is gene-

rally believed that during the latter period the fall in the rate of exchange was due to increased supplies of silver placed upon the Indian markets, though, as will be seen above, the supplies of silver during these 15 years were much reduced as compared with those in the previous 15 years.

But in 1890, 1891, and 1892, the average net imports amounted to Rx.11,378,400, an increase of 65 per cent. as compared with the average of the previous five years. Thus it is evident that in addition to the fall in the gold value of the rupee caused by the appreciation of gold, there was also in these three years the influence at work of largely increased supplies of silver which also depressed the exchange. It will be seen that the average net imports of silver in the five years from 1890 to 1894 amounted to Rx.12,137,717, while in the eight years from 1895 to 1902 they were only Rx.6,412,310. Under the combined influence of scarcity of gold, and increased supplies of silver, together with the prospect of the United States partially or wholly suspending the purchases of silver, the Indian Government found themselves in a critical position. On June 26th, 1893, when the mints were closed, the rate of exchange was 1s. $2\frac{5}{8}$d., and the Government undertook to give out a rupee for every 1s. 4d. in gold paid to them. This rendered it absolutely certain that the rate of exchange could not rise more than fractionally above 1s. 4d. It was frequently asserted that this policy would be a failure, but as the Indian Government received gold which is saleable in every market of the world, and only undertook to give a rupee for every 1s. 4d. in gold, failure could only take place if the amount of silver in a rupee became worth more than 1s. 4d. As that was exceedingly unlikely to happen, seeing that the Government were offering for 1s. 4d. what at the time was only worth 1s. $2\frac{5}{8}$d., the position of the Government was a very strong one, indeed, it was impregnable from the currency point of view.

It is in the highest degree necessary to emphasise the fact that, up to 1890, India's financial troubles were due almost entirely to gold. The silver standard gave India in the 20 years 1873-92 a remarkable degree of prosperity, whereas, if India had been on the gold standard with exchange at 1s. 11d., and prices in 1892 on a gold basis of 68 instead of, as they really were, on a silver basis of 96, it is needless to say that there would have been widespread adversity all over India.

The following Table gives a condensed view of the material facts :—

India.—Rates of Exchange and Net Imports of Gold and Silver.

Years ended 31st March.	Average rate of exchange of Council Bills.	Average net imports of gold per annum.	Average net imports of silver per annum.	
	s. d.	Rx.	Rx.	Rx.
1860-64	1 $11\frac{3}{4}$	5,889,538	10,181,781	
1865-69	1 $11\frac{1}{2}$	5,835,117	9,981,112	7,920,388
1870-74	1 $10\frac{3}{4}$	3,073,776	3.598,271	
1875-79	1 9	639,595	6,408,692	
1880-84	1 $7\frac{3}{4}$	4,128,613	6,205.349	6,503,575
1885-89	1 $6\frac{1}{4}$	3 083,670	6,896,685	
1890	1 $4\frac{1}{2}$	4,615,304	10,937,876	
1891	1 6	5,636,172	14,175,136	
1892	1 $4\frac{3}{4}$	2,413,792	9,022,184	12,137,717
1893	1 3	2,812,683	12,863,569	
1894	1 $2\frac{1}{2}$	641,246	13,719,818	
1895	1 1	4,974,094	6,329,230	
1896	1 $1\frac{2}{3}$	2,525,952	6,582,222	
1897	1 $2\frac{1}{2}$	2,291,038	5,856,030	
1898	1 $3\frac{1}{3}$	4,908,489	8,473,480	
1899	1 4	6,503,408	3,980,784	6,412,310
1900	1 4	9,440,600	3,576,698	
1901	1 4	842,135	9,507,232	
1902	1 4	1,937,600	7,192,800	

At the time of the closing of the mints, a number of fallacies were entertained as to the course of exchange. One was that the Indian Government had, by closing the mints, obtained control of the exchange, and apparently sharing this view, the Secretary of State immediately fixed his minimum for Council Bills at 1s. 4d., and afterwards reduced it to 1s. $3\frac{1}{4}$d. The rate had, at the closing of the mints, been 1s. $2\frac{5}{8}$d., with a downward tendency, and it may be asked what sudden effect had the Indian Government produced that 1s. $2\frac{5}{8}$d. should be transformed into 1s. 4d. or 1s. $3\frac{1}{4}$d.? There was no reason for any such expectation, and the result was that, notwithstanding the practical withdrawal of Council Bills from the exchange market for the last six months of 1893, the average exchange for the year 1893-4 was only 1s. $2\frac{1}{2}$d.

Another fallacy of the period which was almost universally believed in, and was not objected to by Lord Herschell's Committee, was that the surplus exports must begin to flow from India before the corresponding Council Bills could be sold, and from July to December, 1893, the Secretary of State for India acted on that view. The result, however of waiting for the surplus exports to flow from India was that in the absence of Council Bills they did not flow. The following figures show exactly what did take place :—

India.

Six months July to December.	Surplus Exports. Rx.	Surplus Imports. Rx.
1891	7,735,822	—
1892	11,107,802	—
1893	—	1,960.511

The Secretary of State sold only a very small amount of Council Bills in the last half of 1893, and the result was, that as he made no demand on India to pay its current indebtedness, the money being borrowed in London instead, the demand for surplus exports from India was not made, and the balance of Indian trade was turned into one of surplus imports. It is important to observe the rapidity with which the trade immediately adjusted itself to the diminished demand for exports in the absence of Council Bills. In January, 1894, the Secretary of State abandoned his policy of trying to control exchange, or to obtain a higher rate than the conditions of the market warranted, and began by offering his bills at the market rate. The average exchange in 1893-94 was 1s. 2½d., and the rates for the two following years, 1894-95 and 1895-96, were 1s. 1d. and 1s. 1½d. respectively, while in 1896-97 the rate was 1s. 2½d., and in 1897-98, 1s. 3⅗d. These figures would seem to present a difficulty, as the question naturally arises why, after the mints were closed in order to prevent the further fall in exchange, the rate should have fallen by 1½d., or about 10 per cent., that is from 1s. 2½d. to 1s. 1d. No very marked change ought to have been expected to take place immediately after the closing of the mints, though the tendency ought to have been upward.

However, in examining Mr. Sauerbeck's gold index numbers of commodities in London, as given in a previous Table, it is seen that the number for 1892 was 68, and the same for 1893. But in 1894 it fell to 63, in 1895 to 62, and in 1896 to 61, that is a total fall from 68 of about 10 per cent. In "Prices and Wages in India," which gives the rupee prices of Australian gold, the index number for 1893 was 144, in 1894 it was 160, and in 1895 it was 169, while in 1896 and 1897 it was 155 and 154 respectively, when the exchange had again risen to 1s. 2½d. The rise in the rupee value of gold from 144 to 160 was about 11 per cent., and, though not exactly for the same period, the fall in the gold index number of prices in London was about 10 per cent., exactly the same as the fall in exchange from 1s. 2½d. to 1s. 1d., so that these three series of index numbers all pointed to an increase in the purchasing power of gold of about 11 per cent. It is not well, however, to expect too close resemblances where the statistics are taken at points so widely apart and where there may be considerable differences in circumstances, but it is important to show that changes in gold and in rupee prices and exchanges can to a great extent be accounted for.

The conclusion to be derived from the above figures is not that the closing of the mints was a failure because it did not arrest the fall in exchange, but that the purpose of the closing was counteracted for a time by a subsequent increase in the purchasing power of gold and decrease in the purchasing power of the rupee; and, had the mints not been closed, the exchange would have fallen lower still, as a larger amount of silver would have been imported and coined. But for these two changes, it is fair to infer that the exchange in 1894-95 would have been higher than 1s. 2½d., and in 1896-97 would have gone higher still.

The following Table shows the rates for Council Bills and Indian index numbers from 1890 to 1902:—

India.

Years ended 31st March	Average rate of Council Bills. s. d.	Index numbers of exports and imports at Calcutta.* Prices in 1873=100.
1890	1 4½	94
1891	1 6	89
1892	1 4¾	94
1893	1 3	100
1894	1 2½	101
1895	1 1	105
1896	1 1⅔	103
1897	1 2½	101
1898	1 3⅓	93
1899	1 4	97
1900	1 4	107
1901	1 4	111†
1902	1 4	
Averages of periods per annum	1873-1882: 96	1883 1892: 88 / 1893-1902: 102

The Sherman Act was passed in 1890, and in that year the gold price of silver in London, as shown in a previous Table, was 78 on the average, while in India in 1891, the rupee index number of commodities had fallen to 89, both responding to the increased value of silver. The above Table is the most important available in regard to the prices of Indian commodities generally, as it embraces a very

* From a Table from 1873 to 1901, furnished by Sir Henry Waterfield, G.C.I.E., as compiled from index numbers in "Prices and Wages in India." The prices are for January and July.

† For January only.

large number of articles, and it shows that the average of the nine years 1893-1901 was 102 as compared with 100 in 1873. From 1890 to 1892, the gold price of silver fell from 78 to 65, and from 1891 (average of prices of January and July only) to 1892, the rupee price of commodities rose to 94, and in 1893 they were 59 and 100 respectively. Rupee prices of commodities were, in 1889 at 94, in 1893 at 100, in 1894 at 101, and in 1895 at 105, the highest price of the whole period from 1873 up till that year. In 1896 the index number fell to 103, in 1897 to 101, and in 1898 to 93, so that the year 1896 may be noted as the beginning of the contraction of the Indian currency. The 1895 prices are the average of those for January and July, and thus this highest index number occurs, after a period of less than two years from the closing of the mints. The gold price of silver meanwhile fell from 59 in 1893, to 48 in 1894, 49 in 1895, 50 in 1896, 45 in 1897, and 44 in 1898, while in 1902 it fell to 40, and at the end of December, 1902, to 37.

On the other hand the rupee exchange, which, at the closing of the mints on 26th June, 1893, was 1s. $2\frac{5}{8}$d., was still for the year 31st March, 1894, a little above 1s. $2\frac{1}{2}$d.; but in the following year ending 31st March, 1895, it had fallen to 1s. $1\frac{1}{10}$d. on an average, for the year 1895-96, it rose to nearly 1s. $1\frac{2}{3}$d., in 1896-97 to nearly 1s. $2\frac{1}{2}$d., and in 1897-98, to 1s. $3\frac{2}{5}$d. It will be seen, therefore, that the highest point of Indian rupee prices was 105, the mean of prices of January and July, 1895, and the lowest yearly average of the gold exchange per rupee, was 1s. $1\frac{1}{10}$d. in 1894-95.

In connection with the rise of Indian prices from 1893 to 1895, it ought to be recorded that, immediately after the closing of the mints, the Government accepted from banks and others silver to the amount of Rx.2,000,000, which had been shipped to India before the closing of the mints, and coined it. As silver had in the meantime fallen in value as compared with rupees, these Rx.2,000,000 would generally remain as coin, as they were too valuable to be melted down for use in the arts. Then a change was made in the amount of rupees held in the currency reserve, which enabled the Government to withdraw Rx.2,000,000 from the reserve. Thus Rx.4,000,000 were added to the actual circulation, and it is generally believed that a considerable quantity of rupees came out of hoards and passed also into the circulation. From these sources rupees were added that raised the Indian prices to 105 in 1895, and it may have been that the large imports of silver from 1890 to 1893 had also a continuing effect for some time.

The expectation of the Indian Government was that, when all the temporary causes of disturbance incidental to the policy of closing the mints had ceased to operate, and normal conditions had been established, the relative contraction of the currency would set in owing to increased population and trade, without any increase in the coinage of rupees being permitted, while more or less melting by private individuals and loss of coins would, no doubt, take place, and that this would cause a rise in the gold exchange which would naturally be followed by a fall in the rupee prices of commodities. From the above figures it would appear that these two changes began in the year 1895-96, namely, the year following the lowest point of exchange, and the highest point of Indian prices.

In considering the movements of exchange, it is necessary to deal with the factors that enter into it. There are permanent causes that determine a rate, and temporary causes that continually modify that rate without permanently affecting it. A par of exchange between two countries having a gold standard is simply the relation between the coins of one country and the coins of the other. The rate of exchange may fall to a point where there will be a profit on shipping bullion, or may rise to a point where bullion will come from abroad. The par of exchange is the centre around which these movements take place; but fluctuations due to temporary causes are strictly limited. No condition of exports or imports can permanently affect the exchange between these countries; sudden changes in either exports or imports may produce changes of rate, but this can only be for a short time. Nor can large foreign loans or large transactions in exchange do anything more than temporarily affect the rate. In the case of India and England, the question was one of different money systems, and, therefore, in the absence of a fixed international par of exchange, as the amount of gold money or silver money might be increased or diminished owing to special causes affecting either of them separately, there could be no fixed par of exchange. The volume of money in each country fluctuated without regard to the volume in the other, and the moneys of the two were not interchangeable, so that a fixed par of exchange could not be maintained by the transference of bullion from one country to the other.

The prices of Indian commodities were at 105 in 1895, as compared with 105 in 1874, but the English gold prices were represented by 62 in 1895, as against 102 in 1874. The Indian case showed that the rupee had practically the same purchasing power in 1895 as in 1874, and that, therefore, monetary conditions were normal in India, whereas the English case showed that in 1896 prices were 39 per cent. below the average of the 11 years 1867-77, that is, the purchasing power of gold as shown by these prices had risen exactly 64 per cent.

The Indian Government, therefore, succeeded in their policy of connecting India with the gold standard, as 1s. 4d. was reached in 1899, while Indian prices were maintained at a level of 97 and at higher figures in the next two years, and these prices ought to have brought great prosperity to the Indian producers. The rate of 1s. 4d. was of immense importance to the Indian Government, and the stable prices of enormous value to the Indian producers and consumers, while the exporters of merchandise from this country to India got the benefit of a 1s. 4d. exchange in common with exporters and those sending remittances from India.

The foregoing index numbers of exports and imports at Calcutta are the most important series available in regard to prices in India, and these stood at 96 for the average of the 10 years 1873-82, at 88 for the ten years 1883-92, and at 102 for the nine years 1893-1901. These index numbers must be regarded as exceedingly satisfactory from the currency point of view.

The New Currency Standard of 1s. 4d. to the Rupee.

The period of contraction came to an end in the beginning of 1899, when the 1s. 4d. rate was reached, and became effective. The tendency then was for the rate to rise above 1s. 4d., and as soon as it rose to 1s. $4\frac{5}{32}$d. there was a profit on shipping gold to India to be tendered at the currency reserve in exchange for rupees. The Government undertook to receive gold and give out rupees at the rate of 1s. 4d. for each rupee. Thus the Indian currency had reached a gold basis, and a par of exchange had been established with the gold countries, the trade with which amounted to about three-fourths of the whole trade of India. It is true at the same time that it lost the par of exchange with the silver countries with which it carried on one-fourth of its whole trade. But it was impossible that it could maintain the two pars of exchange unless an international agreement was to be arranged, and that at the time of the closing of the mints was regarded as unattainable in the state of opinion of the leading Governments.

Thus India had passed from the silver standard which the Government rightly regarded as much too precarious in the future for the interests of the great Indian Empire, and had passed on to the gold standard. But it was not on to the standard of the gold countries as it existed in India before 1873 that it passed, as that would have been to India an incalculable disaster. The former par value of the rupee before 1873 was 1s. 10⅞d., though the nominal rate was taken at 2s. It is evident, therefore, that if India had adopted the gold standard, with the gold value of the rupee at 1s. 10⅞d., it would have contracted its currency until the rate would have risen to that figure. But instead of this the contraction was only to 1s. 4d., and that made an enormous difference to the people of India. The index number of prices of 45 commodities in London are shown in a Table already given, from before the closing of the mints till 1902, and in 1902 the number was 69, that is, general prices in London had fallen 31 per cent. as compared with what they were in the period from 1867 to 1877. India fortunately did not follow the example of Western countries by incurring this fall in prices of 31 per cent. But it did a much wiser thing. Instead of going back to 1s. 10⅞d., and placing itself on the gold basis of the Western countries, it adopted 1s. 4d. as a gold basis of its own, which is exactly 70 per cent. of 1s. 10⅞d. The consequence was as gold prices had fallen very greatly owing to the scarcity of gold, and were at 70 in 1901 and 69 in 1902, the adoption by the Indian Government of 1s. 4d., that is 70 per cent. of 1s. 10⅞d., enabled them to eliminate from their currency the effect of the scarcity of gold. Had they adopted 1s. 10⅞d. their prices to-day would be 30 per cent. lower than they are owing to the scarcity of gold, whereas their position is that as gold has increased in purchasing power, and 1s. 4d. in gold will now purchase as much as 1s. 10⅞d. did before, they have escaped the fall of 30 per cent. in the prices of commodities to which the gold countries have had to submit. India has had comparatively stable average prices of commodities as has been shown in the Table already given, whereas the prices of the gold

countries are 30 per cent. lower, and the prices of the silver countries were in 1902 about 74 per cent. higher than the level of Indian prices in 1873.

So far as the change of currency basis is concerned, it has practically had very little effect on Indian prices, which are not much higher than they were in 1873. It is not an unusual thing to read of the great injury that has been done to the people and the trade of India, by the adoption of the gold basis of 1s. 4d. for the rupee, but there is no real foundation for such a charge. India has avoided the Scylla of very low gold prices, and the Charybdis of exceedingly high silver prices, and has, to-day, a range of prices dating from before 1873 of such stability, as no other country in the world can show. It must be remembered that the ideal money system of the economists is one that gives stability in the average prices of commodities, because, then, justice will be done between debtor and creditor, between producer and consumer. And there cannot be a shadow of a doubt that India closed its mints at the very time when the stability of its prices was threatened, and thus escaped a serious dislocation of prices and wages, and of debts and credits. This stability in all currency relations is one of the reasons why, in spite of famine and plague, the people of India have been of late sufficiently prosperous to provide the materials of fairly satisfactory budgets. With stable average prices neither the buyer nor the seller has been unduly favoured, and this has enabled a just system of taxation to prevail, because the burden of taxes has neither been increased nor diminished by changes in the currency itself.

Currency Legislation from 1893 till the Present Time.

(1.) The mints were closed to the coinage of silver for the public by Act No. VIII. of 1893, and notifications of 26th June, 1893. The Government undertook to issue to the public at Calcutta and Bombay, through the Commissioners of Paper Currency and the Mint Masters, currency notes and silver rupees in exchange for gold coin and bullion at the rate of 1s. 4d. the rupee, or 15 rupees to the £ sterling.

The Government undertook to accept, in payment of sums due from the public, sovereigns and half-sovereigns at 15 rupees to the £ sterling.

(2.) Act No. XXI. of 1896 authorised an increase to 100,000,000 rupees—of the amounts which may be invested in securities of the Government of India out of the coin and bullion received for currency notes. In 1891 the amount that could be so held had been fixed at 80,000,000 rupees, so this Act released 20,000,000 silver rupees from the currency reserve, and replaced them by a corresponding amount in securities.

On 11th September, 1897, the Government issued a notification by which they undertook to receive at the reserve treasuries sovereigns and half-sovereigns, and to issue rupees in exchange at the rate of 15 to the £ sterling.

(3.) Acts Nos. II. and VIII. of 1898 authorised the issue of notes in India against gold held in London by the Secretary of State as a reserve to secure the payment of such notes. This was designed as a temporary measure of relief to a stringent money market in India, and was only granted for two years, but it was renewed for two years in 1900, and made permanent in 1902.

(4.) The Indian Currency Committee of 1898-9, presided over by Sir Henry H. Fowler, M.P., reported in favour of gold being made legal tender in India, and Lord George Hamilton in a despatch dated 25th July, 1899, recommended it to the Indian Government.

By Act XXII. of 1899, sovereigns and half-sovereigns coined at any royal mint were declared legal tender in India at the rate of one sovereign for 15 rupees.

(5.) Acts No. VIII. of 1900, and IX. of 1902, gave the Secretary of State power to purchase silver with the gold so deposited, and transmit it to India for coinage, and also authorised the issue of notes in India against silver bullion held in England by the Secretary of State as a reserve to secure the payment of such notes.

Gold and Silver under the New Currency Legislation.

The first payment of gold by the public at the currency reserve in exchange for rupees and currency notes, under the new currency legislation, was made in March, 1898, and amounted to £170,280. In February, 1899, the amount paid in was £797,750, and in March £917,811, and the total amount in the reserve on 31st March, 1899, was £2,035,448, so that at that date the gold standard at 1s. 4d. the rupee, may be considered as having been completely established. On 22nd January, 1903, the gold in the reserve amounted to £7,443,000. In the House of Commons on 12th March, 1903, Lord George Hamilton stated that since gold

was made legal tender in India, 25,282,000 sovereigns had been received by the Government of India, 18,825,000 of these had been issued, of which 7,000,000 were sent to England and 11,825,000 were issued to the Indian public.

The following Table shows the amount in the currency reserve at the undermentioned dates :—

INDIA—GOLD IN CURRENCY RESERVE.

	£
31st March, 1898	170,280
,, ,, 1899	2,035,448
,, ,, 1900	7,791,019 1,500,000*
30th Sept., 1900	8,791,618
31st March, 1901	7,115,047
30th Sept., 1901	5,771,000
31st March, 1902	7,109,000
30th Sept., 1902	6,079,000
22nd Jan., 1903	7,443,000

In 1900-01, gold to the amount of £4,000,000 was withdrawn from the currency reserve and remitted from India to England and sold, and £1,600,000 purchased in London and held there as part of the currency reserve was released. In 1901-2, £2,500,000 of gold was remitted to London, partly for investment in Consols on behalf of the gold reserve fund, and partly for other purposes. The gold that went to India came principally from Australia and South Africa. It is evident that as the surplus gold of Australia, namely the amount for export after the local wants have been provided, is to a considerable extent shipped by steamers touching at Colombo on their way to Europe, it is frequently an advantage to land it at Colombo and send it to Calcutta or Bombay, rather than incur the expense of sending it to London when it is wanted in India.

The question may be asked, why did the gold find its way to India at all? It has been shown that the gold standard at 1s. 4d. became effective early in 1899 by the operation of two causes, namely, by the contraction of the Indian currency and by increased supplies of gold in 1898 and 1899 flowing into the gold money countries and also into India. And these two causes have been in operation ever since. The contraction of the currency if left alone, or the increased supplies of gold if acting separately, would very soon raise the rate of exchange to 1s. $4\frac{1}{2}$d. and higher, but when the rate reaches 1s. $4\frac{5}{32}$d. the exchange banks ship gold to India because there is a profit in gold that is tendered there, and when the rate rises to 1s. $4\frac{5}{32}$d., the banks can pay the expense of shipping gold to India, and have a small profit, in addition to which they get rupees out of the reserve for the purposes of their exchange business. When in this manner the banks pay in gold and get rupees in exchange, these rupees are passed into circulation, and thus the rate is continually kept from rising, except fractionally above 1s. 4d. doing so. Practically speaking, the rate will never be allowed to rise to 1s. $4\frac{1}{4}$d. except on some sudden emergency and for a very brief period, because competition will step in and cause gold to be shipped at 1s. $4\frac{5}{32}$. The reason is that a rupee can be got at the currency reserve in India for every 1s. 4d. in On the other hand, as it is impossible to keep the rate at any fixed figure, such as 1s. 4d., it will frequently rise fractionally above, and fall fractionally below that figure.

* Held in England on behalf of currency reserve.

In connection with the par of exchange for the trade with the gold countries, and the stability of the rate of 1s. 4d. under the new currency policy, the following Table is interesting :—

RATES OF COUNCIL BILLS DRAWN ON BOMBAY.

Official Year.	Highest.	Lowest.	Variation between highest and lowest.
	Pence.	Pence.	Pence.
1889-90 ..	$17\frac{15}{32}$	$16\frac{1}{16}$	$1\frac{13}{32}$
1890-91 ..	$20\frac{29}{32}$	$16\frac{15}{16}$	$3\frac{31}{32}$
1891-92 ..	$17\frac{11}{16}$	$15\frac{1}{16}$	$2\frac{5}{8}$
1892-93 ..	$15\frac{31}{32}$	$14\frac{5}{8}$	$1\frac{11}{32}$
1893-94 ..	$16\frac{1}{32}$	$13\frac{9}{16}$	$2\frac{15}{32}$
1894-95 ..	$13\frac{29}{32}$	$12\frac{13}{32}$	$1\frac{1}{2}$
1895-96 .	$14\frac{27}{32}$	$13\frac{3}{32}$	$1\frac{3}{4}$
1896-97 ..	$15\frac{27}{32}$	$13\frac{13}{16}$	$2\frac{1}{32}$
1897-98 ..	$16\frac{1}{8}$	$14\frac{15}{32}$	$1\frac{21}{32}$
1898-99 ..	$16\frac{5}{32}$	$15\frac{3}{32}$	$1\frac{1}{16}$
1899-1900	$16\frac{3}{8}$	$15\frac{15}{16}$	$\frac{7}{16}$
1900-1901	$16\frac{5}{32}$	$15\frac{29}{32}$	$\frac{1}{4}$
1901-1902	$16\frac{1}{8}$	$15\frac{29}{32}$	$\frac{7}{32}$

The highest rate of exchange obtained for council bills drawn on Bombay was 1s. $4\frac{5}{32}$d. in both January and February, 1899, after which the rate fell off until again it reached 1s. $4\frac{5}{32}$d. in October, November, and December, 1899, 1s. $4\frac{3}{8}$d. in January, 1900, 1s. $4\frac{7}{32}$d. in February, but in January, 1901, it had fallen to 1s. $4\frac{1}{8}$d. In the official Tables, the quotation for highest and lowest rates on Bombay are given to smaller fractions than those for Calcutta and Madras.

It will be seen, therefore, that the variations in exchange were very great before the closing of the mints, and that from 1893 up to 1899 the variations were still considerable. In the three years since March, 1899, when the rate of 1s. 4d. became effective, the annual variations between the highest and lowest rate have only been from ¼d., to less than ½d. This remarkable stability in the rate of exchange is of the very greatest importance for the external trade of India and for the Government finances, and it is accompanied by comparative stability in Indian prices of commodities for the external and the internal trade. Under normal conditions there will always tend to be a natural contraction of the currency, and the only method by which this contraction can be overcome, is by adding rupees to the currency, and new rupees can only be obtained by importing gold and exchanging it at the reserve, and then, as too much gold accumulates there, and the supply of rupees becomes depleted, gold is withdrawn from the reserve, and silver is bought with it and coined into rupees. On the other hand, when gold is produced in increased quantity in the world, it tends, by means of the gold exchanges, to flow to all places where there are mints open to receive gold, and by this process the Indian rate of exchange rises; but the gold itself, passing to the Indian reserve, and having rupees exchanged for it, checks the rise and lowers the rate of exchange by increasing the volume of the currency.

India being, therefore, on the gold standard, its currency follows the course of gold. When there are large supplies of gold, India gets its share of the gold, and Indian prices of commodities rise with prices in the gold countries. For some time to come, at least, there is every probability that the supplies of gold will tend to increase, so that Indian prices are likely to be more than maintained for a considerable time to come. India has now a system of currency which very closely resembles that of France, it has a gold currency and reserve, it has a silver currency, namely, rupees of unlimited legal tender, gold can be tendered at the reserve but not silver, and while it will take gold in exchange for rupees, it is under no obligation to give out gold in exchange for rupees. It must be understood that there is no mint for gold in India, but as most if not all of the Australian gold comes to India in the form of sovereigns, the coinage of gold in India is unnecessary.

So long as the rate of exchange had not reached 1s. 4d., no gold was shipped to India for currency purposes, and after it began to be shipped a large amount had to pass into the currency reserve in exchange for rupees before the proportion of gold in the reserve became so great and that of rupees became so limited, that the Government had to withdraw gold and sell it for silver to be coined into rupees for the currency reserve. In 1899-1900, however, purchases of silver were made in England for the Government of India to the amount of £405,000. In 1900-01 the purchases in England amounted to £5,649,924, of which £1,600,000 represented the value of silver purchased by gold previously held in this country as a reserve to secure the payment of currency notes issued in India. In 1901-02 the purchases in England only amounted to £2,900. In India the total purchases of silver during the above period amounted to about £1,250,000. The whole of the silver purchased in 1899-1902, amounting to about £7,300,000, was coined, in addition to uncurrent and native coins valued at about £4,800,000. The profit to the Government on the coinage of new rupees is placed to the gold reserve fund, which now consists of £4,052,561 in Consols.

Agriculture under the Currency Legislation.

The chief object which was aimed at by the Act of 1893 was to arrest the fall in exchange, and this became the more necessary after 1890 owing to the excessive supplies of silver that found their way to India from that year onwards, in spite of the large purchases of that metal by the United States from 1890 till 1893. Up till this period the conditions of the internal trade of India had been comparatively speaking normal, and only the gold exchange and the trade with the gold countries had been affected. But the increased supplies of silver as shown in the Table of net imports into India, now threatened to have a substantial effect on Indian prices. The closing of the mints stopped the flow of new rupees into the currency, and warded off the apprehended rise of prices while it initiated the movement that ultimately brought the exchange to 1s. 4d. In 1895 average prices in India were at 105, the highest point reached since 1874, when 105 was the index number, the prices of 1873 being taken as 100. As will be seen in the Table of Indian Index Numbers, the prices in 1900 at 107, and in January, 1901, at 111, are higher than any number in 30 years, so that the generally

accepted view that the adoption of the gold standard at 1s. 4d. has led to a fall in prices is entirely erroneous, and is at the bottom of most of the misconceptions as to the effect of the currency policy in India.

If the rates of interest of the Bank of Bengal are considered it will be found that in 1899 and 1900 they reached 10 and 12 per cent. per annum in the first four months of both years, in 1891 and 1892 they were very low, in 1894 they were as high as 11 per cent., in 1895 and 1896 they reached 8 per cent., in 1897 and 1898 they were very high, and in 1899, 1900, and 1901 they were moderate, that is not exceeding 8 per cent., and that only in two months in each year. It has already been explained that in 1898 the Indian Government authorised the issue of notes in India against gold held in London by the Secretary of State as a reserve to secure the payment of such notes. This enabled the banks to deposit gold in London, and at once receive notes or rupees in India, thus giving a means of relief for a stringency in the money markets in India, which had not been hitherto available. It is probable that further experience of the working of the currency policy may induce the Government to provide further means of relief in times of stringency. The official figures of the Bank of Bengal show, however, that in the three years since the 1s. 4d. rate became effective, there has been no exceptional monetary stringency in India.

One of the most important questions to be considered is the effect of the new policy on the internal economy of India. Statements have been circulated very widely in both the English and the Indian press that the Government, in order to keep up the rate of exchange for their payments in gold, have sacrificed the interests of the trading, the agricultural, and industrial classes. Fortunately, though these statements are vague, they are capable of being brought to a complete economic test. If the people of India have suffered injury from this policy, this injury must be visible in their economic condition. Of course it must be borne in mind that questions in no way connected with the currency policy are beyond the scope of this paper. But the broadest test of all that can be applied to the Indian people is the prices which their products command. Almost the whole influence that currency can exercise in a country working on civilised methods, is to raise or lower the average prices to be obtained for commodities, or, what is the same thing, to make money more abundant or less abundant. What, then, has been the course of Indian prices since the closing of the mints, and particularly since the rate of 1s. 4d. became effective in 1899? Let us take 10 leading articles of production, all of which are also articles of export, and nearly all products of agriculture, namely, cotton, cotton yarns 20's, rice, wheat, opium, indigo, jute, gunny bags, linseed, and tea. The average of the prices of these ten articles for 1873 is taken as 100, and the figures following show whether prices have risen or fallen in the last 30 years. The detailed figures for each article can be seen in "Prices and Wages in India," and in Mr. O'Conor's "Annual Review of Trade":—

India.—Index Numbers of 10 leading Articles of Export at Calcutta.

The prices of 1873 are taken as 100.

Year.	Index Number.	Year.	Index Number.	Year.	Index Number.
1873	100	1883	93	1893	120
1874	112	1884	109	1894	114
1875	105	1885	97	1895	110
1876	100	1886	99	1896	108
1877	113	1887	91	1897	114
1878	113	1888	99	1898	97
1879	114	1889	110	1899	90
1880	114	1890	106	1900	108
1881	110	1891	95	1901	108
1882	105	1892	112	1902	107
Averages of 10 years.	109		101		108

That is the economic history of these 10 leading articles for 30 years, and from the point of view either of the producer or the trader, they must be regarded as eminently satisfactory. The first 20 years, that is 1873 to 1892, with an average of 105, will be admitted by all who have a knowledge of the subject to have been a period of great prosperity to the people of India, while in the second 10 years the average (101) is lower than in the first (109) and the third (108), though the first 10 years and the third 10 years have practically the same average. In the list of these 10 articles, there are two to which special attention ought to be directed, namely, tea and indigo. The prices of both have fallen considerably; tea, in consequence of overproduction, and indigo, in consequence of the competition of a chemically prepared article. It is evident that the currency policy had nothing to do with bringing about these low prices. The simple fact

in regard to tea, is that the increased supply was considerably beyond the demand for it at the previous prices, and lower prices had accordingly to be accepted. It has been already remarked, that so far as the great mass of the people of India are concerned, all that the Government can do is to provide a basis of currency, which will be just or unjust according to the volume of money in circulation, and the supreme object at which economists aim, in connection with currency, is to find a system that will maintain comparative stability in general prices, and thus do complete justice between producer and consumer. It must be remembered, at the same time, that a currency system can only provide a basis for general average prices of commodities, while supply and demand must regulate the prices of individual articles. The Indian Government have supplied a currency basis, which ought to give comparative stability in average prices, but the movements in the prices of each individual article are entirely beyond their control. It so happens that no country in the world can show such a stable range of prices as these 10 articles in India, in the last 30 years. Another series of index numbers of practically all the articles of export and import at Calcutta has been partly quoted to the same effect, but perhaps it may be well to show also how cultivators have fared in connection withthe prices of seven food grains, as calculated from official tables:—

Indian Prices of Rice, Wheat, Jawar, Bajra, Ragi, Gram and Barley, at Selected Centres.

Prices in 1873 *are taken as* 100.

Year.	Index Number.	
1873	100	
1883	97	
1887	118	
1889	120	Average 132
1890	121	
1891	137	
1892	147	
1893	129	Average 132
1894	114	
1895	121	
1896	164	
1897	209	Average 168
1898	140	
1899	137	
1900	195	
1901	160	

Averages of periods per annum:—

1873-1882.	1883-1892.	1893-1901.
121	118	152

We see then that these seven food grains have risen in the last five years to an average index number of 168, although famine has to be taken into account during this period. But at least it is worthy of notice that the four years before the closing of the mints and the four years after had the same average index number, namely, 132, while in 1901, the number was 160. Hence it may fairly be concluded that the closing of the mints had no effect whatever on the price of food grains in the four years after the closing, and the much higher prices of the last five years do not make a proper comparison as they include a famine period. It ought to be explained, however, that these prices are taken at a number of selected centres, mostly in the interior, where improvements in communication and other local causes have doubtless contributed to the rise in prices. These prices in the interior would not, however, be selected to show changes due to currency causes, as for the latter purposes prices would be taken at Calcutta or Bombay. But at least they show higher prices to the cultivator, whereas it is frequently alleged that the currency policy has produced lower prices.

So far then as the ten leading articles of export, almost all derived from the soil, are concerned, and the seven leading food grains, the adoption of the gold standard has, in my opinion, made very little change, and it ought to have made very little change. The position of the cultivator has, therefore, been in no way impaired since 1893, indeed, it has been improved in the last five years by higher prices for food grains, and by higher prices generally in the last ten years than in the previous ten.

The Indian Currency Committee of 1898-99.

In 1897 the French and American Governments made proposals to the British Government that if the Indian mints were reopened to silver at the ratio of 1 of gold to $15\frac{1}{2}$ of silver, and if certain quantities of silver were agreed to be held by the Government or by the Bank of England, then these two Governments would open their mints to silver. The proposals were submitted to the Indian Government but the latter felt themselves unable to accept the terms, and immediately on receiving this decision, the Home Government closed the negotiations. The average price of silver in 1897 was 27 9-16d., and the proposals of the two Governments contemplated the opening of the French,

American, and Indian mints at 60·84d. The change would certainly have been enormous, but perhaps some practicable method of arriving at that high price, or at a lower price, by slow degrees, might have been devised if the negotiations had really been taken up in earnest.

A considerable amount of agitation in favour of reopening the Indian mints had taken place ever since 1893, though public opinion was divided on the subject. and at last on 29th March, 1898, the Hon. Vicary Gibbs moved in the House of Commons for a Select Committee or Royal Commission to be appointed to consider the monetary condition of India and the effects of closing the mints. Lord George Hamilton responded by acknowledging the need for inquiry, but he objected to a Select Committee or a Royal Commission, and consented to appoint a Departmental Committee. This Committee was appointed on 29th April, with Sir Henry H. Fowler, M.P., as Chairman, the entire Committee consisting of eleven members. In the meantime proposals from the Indian Government in regard to dealing with the currency were published. They contemplated the melting down of rupees so as to contract the currency with rapidity and certainty, and it was proposed that 10 crores of rupees should be melted down at a time, and the silver bullion sold, while gold was to be bought, £5,000,000 at a time, and substituted in the currency for the melted rupees. It is unnecessary to deal with these proposals in detail, as in the meantime the rate of exchange went on improving, and the monetary position had soon changed to such an extent that the reasons for melting rupees rapidly disappeared, and the whole of the proposals were abandoned.

The Currency Committee took evidence in 1898 and in the earlier part of 1899. On 7th July 1899 they issued their report, but in the meantime in February and March the arrivals of gold at the currency reserve were very large, and on March 31st the gold in the reserve amounted to £2,035,448. The report practically approved of the then existing system that had arisen by the closing of the mints, but before the Committee made their report the gold standard at 1s. 4d. had already been firmly established. Their principal recommendation was that gold should be made legal tender, and that was accordingly carried into effect, the result being that India obtained both a gold standard and a gold currency. The great mass of the circulation, however, consisted of silver rupees as tokens, so that the Indian currency now responds under an automatic gold system to the movements of gold in the gold countries. The currency reserve takes in all gold tendered and gives out rupees at 1s. 4d. in gold per rupee. When, therefore, the exchange rises to the shipping point of gold to India, gold is shipped. The Indian currency is as completely automatic as that of any of the gold countries such as England or France, though this most important point seems to be but very little understood. There is no more interference with the automatic character of the currency in India than there is in England. At the same time it ought not to be lost sight of that there is only merit in a currency being automatic if the volume of money is such as to do justice to both debtor and creditor. An automatic currency that works great injustice is bad, and a non-automatic currency that enables justice to be done is good. Currency is merely a means to an end, and that end is justice.

It is somewhat strange to have to record that most of the witnesses before the Currency Committee who testified as to the method of establishing the gold standard, expressed the opinion that it could only be introduced if a loan of from £10,000,000 to £30,000,000 were made to provide gold to secure its successful introduction. Not a single witness foreshadowed the manner in which the Indian currency at last found itself firmly established on a gold basis without any loan and with no difficulty whatever, by the mere automatic contraction of the currency until the exchange rose above 1s. 4d. to the shipping point of gold, and gold flowed in as often as the exchange reached that point. In this manner more gold flowed into the currency reserve than the Indian Government knew what to do with, and they had to sell about £7,250,000 of gold in 1899-1900 and 1901-1902 so as to purchase silver to be coined into rupees.

Labourers and Wages.

As Indian prices of agricultural articles of export have been shown to be comparatively unchanged during the last thirty years, though higher on the average of the last ten years than of the previous ten years, this is a perfectly clear demonstration of the fact that the policy of closing the mints has not caused a fall in prices as is so frequently alleged. The cultivator, therefore, with somewhat increased prices for his products, has no valid complaint to make against the new departure

in currency. The increased prices of the seven chief food grains emphasize still further that the cultivator has had a decided advantage in respect of these.

It is evident, therefore, that if the currency policy has maintained stability in prices, that is a complete vindication of the policy so far as industries and agriculture are concerned. Now the question comes, how has the labourer been affected by this policy? So far as prices of the necessaries of life are concerned, the cultivator has had the advantage of somewhat higher prices in the last ten years, and the labourer has had to be at some disadvantage in having to pay these higher prices. But the general impeachment of the policy is that it has produced lower prices and increased the burden of the cultivator. This view is, however, entirely disproved by the facts.

The labourer has, it is true, some complaint in so far that the prices of food have been higher, in the last ten years, but it must be considered that there have been other causes at work to raise prices, namely, drought leading to famine, and also plague. The other question that is of vital concern to the labourer is his wages. A general examination of the statistics in "Prices and Wages in India," does not reveal any very marked change in wages since 1893. There are many variations during that period, and there has been some advance, but there is no proof whatever that the currency policy has affected wages, though other causes have doubtless had some influence upon them. And judging by the fact that the Indian basis of currency is now the same as it was before 1873, and has been ever since 1873, and that prices are also on much the same level, with a somewhat higher range during the last few years than in the last thirty, the conclusion to be arrived at is, that the currency policy of the last ten years has given great stability in prices and wages, which means great stability in the monetary conditions under which agriculture and industries are carried on, and under which taxes and duties are levied. Open mints would have produced greatly inflated prices, whereas the new policy has maintained stability in prices and wages, and no currency policy could have accomplished more.

But it may be well to consider what the effect would have been on the internal economy of India, if the mints had not been closed, and if India had continued on the silver standard along with China, Hong-kong, the Philippines, Indo-China, the Straits Settlements, the Federated Malay States, and Mexico. The bullion value of the rupee to-day, is about 8¼d., and if the mints had remained open, and silver had flowed freely in for coinage, it is safe to assume that the rate of exchange of the rupee would not now have been higher than 11d. That is to say, it would have required, with the rupee at 11d., 145 rupees to make a purchase of commodities that with the rupee at 1s. 4d. only requires 100 rupees. The payment of the home charges would have required 45 per cent. more rupees than are needed to-day, all debts and fixed amounts at interest in rupees would have been repaid in rupees of a purchasing power of 30 per cent. less than the purchasing power of the rupee of to-day. Then the prices of the exports and imports at Calcutta, and the seven chief food grains, regarding which I have quoted the figures, would have been raised 45 per cent. higher than the prices of to-day, or than the average prices of the last thirty years.

The result would have been a very serious advance in general prices, in which the cultivator would have gained at the expense of the other classes. That would have been a change due to an inflated currency, whereas the present stable range of prices that has practically existed for more than 30 years demonstrates that the Indian currency has been for that period, as it is to-day, a stable currency, more stable, indeed, than any other currency in the world. However, if the mints had been kept open we should have had an appeal to the Home Government to defray a part of the expenses of the Government of India. The addition to the taxes necessitated by this monetary dislocation would have been so great that at the time the statesmen of India did not see the possibility of finding new sources of taxation for the purpose, or of increasing existing taxes in any manner adequate to the prospective requirements. In the debate in the House of Commons on 29th March, 1898, Lord George Hamilton used these words:—"What was the position that the late Government had to face? I do not want to use language too strong, but India was unquestionably on the verge of bankruptcy. She could not pay her way, and one of two things was inevitable, either that she would be unable to meet her obligations, or that this country would have had to come to her aid." Now, if that was the position of India, and it cannot be doubted that it was, when the mints were closed and when silver was at 39d., and the rate of the rupee exchange was 1s. 2⅝d., what would it

have been to-day if the rate had fallen to 11d. and prices were 45 per cent. higher than they are? By the adoption of the new policy, India saved itself from a great national calamity which would inevitably have overtaken it if the mints had been kept open.

The Indian ryot is entitled to every consideration, and his interests must always be a subject of great solicitude to any Indian Government. But the Indian labourer is entitled to even more consideration because, unhappily, his life is spent on the borderland of starvation. Now with open mints the ryot would have received vastly increased prices for his produce, prices to which he had no claim whatever, but where would the enormous class of labourers and their dependants have found the money to pay these greatly increased prices? Wages would not have risen *pari passu* with increasing prices, and there would have been a great amount of dislocation in the internal economy of India and widespread suffering among the labourers and their dependants, who, as has already been stated, are much worse off than the ryots. In periods of drought as soon as there is no longer any employment for labourers, the latter and their dependants immediately have to be supported by the Government, but while the whole of the labouring classes in the famine districts have to be supported, only a small percentage of the total persons relieved are ryots and their dependants. The consequence is that the labourers are in far more need of protection and consideration than the ryots, and under the present currency policy they have both had justice done to them, the ryot by having higher prices for his products, and the labourer by having the benefit of somewhat increased wages and fairly stable general prices.

The Currency Policy and Silver Ornaments.

It has been already remarked that no important change can take place without causing some injury, though the benefits may vastly outweigh the drawbacks. There is no doubt that natives who possessed silver ornaments, and most of them would have some ornaments, were placed at a disadvantage by the closing of the mints. At the same time the disadvantage has been greatly exaggerated. When the Famine Commissioners were investigating into the views of the natives as to their ornaments, they did not find that any serious objection was taken by the ryots to the mints being closed. Their view was that they could replace their ornaments at a cheap rate when times improved. Had the mints remained open the rupee would not to-day be higher than 11d., whereas the injury done to the natives is frequently described as if his loss consisted in not being permitted to tender ornaments at the mints and receive in return rupees worth 1s. 4d. each. Thus immense percentages of loss are stated which will not bear examination.

The loss on ornaments is nevertheless a very serious matter, and it must be regarded as the one great disadvantage of the closing of the mints. The silver in a rupee is to-day worth about 8¼d., and 11d. may be regarded as a very high estimate for the rupee if the mints had remained open, as the amount of silver that India absorbed in the form of currency when the mints were open was not very great, probably not more than Rx.2,000,000 or Rx.2,500,000 at most per annum, when the net imports did not much exceed Rx.6,000,000.

As soon as famine set in, the scanty store of ornaments in the possession of the labourers proved but a slender resource, and the latter almost immediately went on the relief works. The statistics of the Indian mints, however, show that it was only in famine times that country silver and ornaments were sent to the mints in any quantity that called for special remark. So that only for a limited amount of silver ornaments was advantage ever taken of the mints, though of course they would be saleable everywhere on the basis of the mint price. At present ornaments are only saleable at their value as silver, but as there are silversmiths everywhere throughout India, there is a current price for silver in every village. It is to be deplored that the natives should sustain any loss on their ornaments, but the Act that closed the mints to their ornaments also closed the mints to an enormous increase in the prices of the necessaries of life, and thus saved them from evils infinitely greater than any they can have sustained by the mints having been closed to their ornaments.

Concluding Remarks.

The question of the currency policy, and its results may now be summed up in a very few sentences. When the mints were closed, the rate of exchange was falling rapidly owing to wo causes, the increase in the purchasing power of gold, and the increase in the net imports of silver into India. From 1873 till

1892 Indian prices of commodities were comparatively stable, but the process had then set in by which rupee prices of commodities began to rise in response to the increased quantities of silver arriving in India. As gold was thus becoming more valuable, and more and more rupees had to be raised by taxation to defray the home charges, that was a difficulty which could no longer be trifled with. And as the rupee itself was becoming less valuable, owing to increased supplies of silver as was shown by the rise in Indian rupee prices of commodities, this threatened to lower the rate of exchange and to raise Indian prices to a very material extent.

Therefore, to arrest the rise in Indian prices, due to excessive supplies of silver, with the very great probability of further large supplies becoming a permanent factor in the currency, and to arrest the further fall in exchange, owing to the increasing purchasing power of gold, the mints were closed. It has been shown in the course of this paper that Indian average prices have been comparatively stationary for the last thirty years, whereas if the mints had remained open they would now have been at least 45 per cent. higher than they are. It has been shown that the change in the currency basis of the rupee, as valued in gold, from the former par of 1s. 10⅞d. before 1873 to 1s. 4d. at present is a fall of 30 per cent., 1s. 4d. in gold to-day purchasing the same amount of leading commodities in London as 1s. 10⅞d. did thirty years ago. Therefore a rupee to-day purchases just about the same amount of average Indian commodities as it did thirty years ago. Whereas in the gold countries general prices are to-day 30 per cent. lower than they were thirty years ago owing to the relative scarcity of gold, India has escaped any such misfortune by taking a new par of exchange, namely, 1s. 4d., exactly 30 per cent. below the former one, so that India has thus placed itself on an automatic gold system without any currency change in the purchasing power of the rupee. This is the crux of the whole question. India has passed on to the gold standard, but at a changed valuation in gold for the rupee by which stability is maintained for average prices, a result that no other country in the world can show for the last thirty years. The Indian Government have, wittingly or unwittingly, established a currency policy that, considering the present range of gold prices in London and rupee prices in India, could hardly be improved upon from the currency point of view. Average prices have been comparatively stationary, agriculture and the industries have all benefited from this stability, and so far as currency is concerned, there has been quiescence and not dislocation in the internal economy of India. Wages have on the whole somewhat advanced, and the labourer has had his reward, while the comparative stability of general prices has been an immense benefit to him. He has lost something in the value of his ornaments by the mints being closed, but, on the other hand, if the mints had been open and he had received a higher price for his ornaments, he would have had to pay at least 45 per cent. more for the necessaries of life.

The conclusion, therefore, that follows from the foregoing facts and figures is that the closing of the mints was in the circumstances inevitable, and in its results was one of the most fortunate events in Indian history, as it provided the means of maintaining the economic position of the Indian agriculturist, labourer, manufacturer, and trader unchanged and unimpaired, so far as any currency policy could accomplish that object, and at a time when but for this policy India would have passed on to currency conditions which would have produced national disaster.

DISCUSSION.

The CHAIRMAN thought the facts and figures which an economist could deduce in support of his contentions in regard to a subject like the one under consideration, more or less abstruse, must necessarily be of a dry, and sometimes even of a repelling character, but the author had handled his facts and deductions with skill and ability, and had invested them with an amount of freshness which was most attractive. He had marshalled and grouped his figures so as to present them in the most entertaining and interesting light, and it was, therefore, a pleasant privilege to express, on behalf of the meeting, their grateful acknowledgements to the author for his valuable, and, in many respects, masterly paper. He (the Chairman) had said that the subject was an abstruse one. He did not know that there was any other subject in the world, except, perhaps, theology, which had a more unenviable notoriety for causing controversy, and a certain amount of heat; but the particular aspect of the question with which the author had dealt could in no way be described as an abstract question. Far from it. A question which affected hundreds of millions of people in their most intimate economic relations, which affected their very conditions of existence; and the not less impor-

tant issue of the prestige and popularity of British rule in India could not be said to be anything but a subject of the most tremendous import, and of burning actuality. What was the problem? It was whether the altered conditions of the currency which had been created under the new scheme, which, as the author said, only began to operate effectually since 1899, had achieved the purposes and objects for which it had been called into being. There was no doubt that if the question was viewed broadly, the verdict would be that the currency basis had succeeded; and he was glad to say this in the presence of Sir J. Westland, who was responsible for launching and piloting it; but it could not be overlooked that there were others who, rightly or wrongly, wisely or unwisely—and as he thought, rightly—on looking deeper, and on analysing the effects of the scheme upon the not unimportant sources and means of public wealth, came to the conclusion that the complaisant attitude assumed in regard to the subject by some unofficial classes, and mainly, if not wholly, by the official bureaucracy in India, was somewhat premature and misplaced. Coming to closer quarters—What was it that the reader of the paper had set himself to prove? It was that the scheme had proved itself an unqualified success. How did he arrive at these conclusions? He based his deductions upon an approximation of the par level of the rating of silver coins to gold in countries of the Latin Union since 1873, namely, 1s. 10$\frac{7}{8}$d. to a rupee. He (Sir E. Sassoon) confessed that, to a great many people, he thought that would be a revelation, because it used to be an accredited belief that 2s. was the par value. But he had no doubt that Mr. Barr Robertson was perfectly correct. Taking that level of the Latin Union, and comparing it with the rating of the rupee in India at 1s. 4d., he arrived mathematically at the conclusion that the difference of exchange between 1s. 10$\frac{7}{8}$d. in 1873, and 1s. 4d. at the present moment, was represented by 30 per cent. The author proceeded to contrast the depreciations that had taken place in the gold value of commodities since 1873, which, with a curious coincidence, equally recorded a difference of 30 per cent., *i.e.*, up to the year 1892-3, when the mints were closed in India. Mr. Robertson, therefore, triumphantly argued that the rating of the rupee, which so accurately represented, and so faithfully reproduced the corresponding depreciation in the gold values, could not but be a just and most equitable arrangement. He had also stated that at present the rupee in India was capable of purchasing as large a quantity of commodities as it did in 1873, when the rupee stood at 1s. 10$\frac{7}{8}$d. These two things were most remarkable. He (the Chairman) thought it would be perfectly futile for him to attempt to traverse the accuracy and soundness of those conclusions, because once the accuracy of the data was admitted—and he feared it could not be refuted—they were bound to consider those conclusions to be natural and legitimate. At the same time, if India had dealings only with gold countries, it would be said that all those who had been agitating for an inquiry, who had been criticising the subtle action and working of the new currency scheme, should be laughed out of court, and that their position was not at all tenable. But India's industrial and commercial relations with silver-using countries dated from time immemorial. Those relations were interwoven with the fabric of her splendid past, with the history and record of her progressive development and expansion, long before British rule and power commenced introducing into India Western methods of civilisation. Therefore, if he judged aright the results of the scrutiny of those who took an opposite view to that expressed in the paper, he would say that, while the deductive methods adopted by Mr. Barr Robertson (who fairly admitted that a certain amount of injustice had inevitably been done) did actually establish the general principle for which he stoutly contended, namely, the absolute stability of average values, and of wages in India, the inductive process of demonstration upon which others relied, seemed to vary, and, to a certain extent, to modify the value of the efficacy of the principle deductively obtained. India exported largely, both of her produce and of her manufactures, to silver-using countries: he noticed that Mr. Barr Robertson put it at 25 per cent. of the whole of her trade, which appeared to be accurate. He did not take into calculation imports from silver-using countries into India, because they were comparatively insignificant. Another fact which seemed to bear upon the subject was the depreciation of the accumulated treasures of India, of which the reader of the paper made somewhat light. The last estimate he had seen of their value was 200 crores of rupees, or Rx. 20,000,000, but he noticed that the Viceroy had estimated the amount at 825 crores, or Rx. 82,000,000. A further point was, whether any alteration in the incidence of taxation in India had been brought about, and burdens thrown upon the shoulders of certain classes in favour of other classes, by the fact, which he did not see could be got over, that far less rupees or coins were obtained by the Indian manufacturer and producer than he would have obtained with open mints. He fully admitted Mr. Barr Robertson's contention, that if there was an open mint the purchasing power of the rupee would have depreciated considerably, but he doubted whether it would have depreciated so much as under the present system. Another thing to be remembered was that the merchandise sent from India to silver-using countries was in a very parlous condition, because of the displacement that had taken place between the natural silver dollar and the Government-managed rupee, amounting to something like 60 or 70 per cent. He had not yet seen proved, and he did not think the reader of the paper had attempted to prove, that any compensation had been received by those engaged in the Indian

trade with silver-using countries at all commensurate with the difference, something like 80 per cent., between the natural rupee and the 1s. 4d. rupee. Mr. Barr Robertson had also said that the level of price of the coarser food grains in India had risen very considerably, something like 36 per cent. within the last four or five years, but he was cautious enough not to commit himself to the view that any such appreciation in the value of exportable grains had taken place, so as to indemnify the producer for any loss that he sustained on account of his getting less rupees for his produce. Mr. Barr Robertson said that the producer obtained more rupees. He (the Chairman) was not in a position to argue to the contrary, but, taking a superficial view, it seemed to him that, as regards Indian produce sent to gold-producing countries, in so far as that produce came into direct competition with produce cultivated in gold countries, and produced under totally different conditions from those prevailing in India, in so far as that produce, owing perhaps to its limited quantity, was not able to deflect the basis of prices that gold obtained in its favour, the Indian producer received less rupees, whatever the value of the rupees might be. His produce was sold upon a gold basis, which was affected, not by the conditions of the Indian producer, but by the conditions which prevailed in producing the gold produce. He might be wrong, but he thought that was the vulnerable joint in Mr. Barr Robertson's armour. At the same time, he felt bound in justice to say, that the remarkable increase in the volume of exports of grain and food stuffs from India to gold-using countries which had taken place during the last three years certainly worked against the theory of those who maintained that the Indian ryot was being very hardly treated by the gold rupee. One could not, however, help regretting that there should be a necessity to deprive India of the benefits accruing from the element of elasticity which was afforded by an automatic currency. Mr. Barr Robertson had told them that the present currency was practically automatic, because gold could come in and command the number of rupees required; but the gold could not always be obtained, except there was a sufficiently large volume of trade to get the quantity of gold needed. Under automatic conditions the rupees required would have been obtained much more easily. While he had always consistently maintained that the present condition of the silver market, and the possibility of India being deluged by large shipments of silver, made it perfectly futile to think that there could be any reversal of the present policy of India, he still inclined to the view that some inquiry should be undertaken by the Indian Government. Difficult and complex as such an inquiry would be, it might conceivably enable them to judge whether some shifting of the burden of taxation, some re-casting of the provincial and Imperial system of taxation in India, might not be demanded by the justice of the case, or some re-modelling of the fiscal arrangements by which excise was exacted where no tangible protection resulted. He hoped that the frankness of his criticism did not debar him from expressing to the reader of the paper how highly they thought of the enormous pains, and the conscientious and painstaking research, he must have devoted to the work, which entitled him to their sincerest commendation.

Mr. J. M. MACLEAN heartily joined with the Chairman in the note of appreciation of the momentous character of the question with which the author had dealt, and the masterly way in which he had handled it. He thought the Government of India was to be congratulated on having found in him such an uncompromising champion. The author did not admit any fault whatever in the scheme of the Government, except that perhaps the poor people of India had lost a little money, say, perhaps, a score of millions sterling, on the silver ornaments they possessed; that was the sole blot Mr. Robertson could discover in the wonderful system. For his own part, he had never applauded the action of the Government of India in introducing the artificial currency, and had the honour five years ago of seconding in the House of Commons the protest made by Mr. Vicary Gibbs against the introduction of the policy, when he described it as nothing but a bastard kind of bimetallism, and that was what it remained at the present day. Sir Michael Hicks-Beach then made a remarkable stand in the House of Commons against the introduction of bimetallism into this country. In passing, he thought, the author went a little far when he said that the Indian currency system was preferable to that of any other country, and more stable. Was there anything unstable in the currency of this country, which had been maintained so long, and which would always be maintained by the English people? Sir Michael Hicks-Beach saved them from bimetallism in this country, but the Government gave up India as a vile body to be experimented upon by the bimetallists there. The author had said that the state of India at that time was perilous in the extreme. It seemed to him that Mr. Robertson confused the Government of India with India itself, and with the interests of the people of India. The Government of India was, no doubt, in a very desperate condition at that time; it had to pay about £3,000,000 a year additional on its remittances to this country, and on account of the fall in the value of silver. There were other forces of a very powerful character arrayed in support of the Government of India, in introducing the change. Not only had the Government to pay those large sums, but the interests of all the European classes in India were very severely affected. Every official of the Crown, civil or military, lost a considerable sum on the remittances he had to make to this country. The interests of the European importing houses in India were also affected adversely by the steady fall in silver in that country. All these powerful forces

were banded together to bring about a change, which was carried into effect. No doubt it had done good to the classes who introduced and carried it, and who were the executive Government of the country, but had it done any good to India? Were the natives consulted about the policy; were their interests ever looked at? Nobody could say, to-day, that India was more prosperous now than she was at that time. Did not India prosper greatly under free silver in those days? Were not imports and exports constantly growing? The author gave statistics, but what was their value? All the present trading returns of India, and all the figures of the Budget were made under an abnormal system; everything was over-valued. The rupees were put at 1s. 4d., so that it was impossible to trust any of the statistics as showing the real condition of the country. The Chairman had delicately referred to what the inevitable result of the change must be upon the exporters and producers in India. It stood to reason that it was utterly impossible for the producers in that country to get the same return for the produce they sent to England that they used to get under the old system. The author spoke, not very definitely, of prices being raised, but how could they be raised? Had the price of Indian wheat, which had to compete with wheat from America, and all parts of the world, been raised in the English market? It was the price in the English market which determined what the Indian exporter received, and the value he received was settled on a purely artificial basis. The Indian producer sold his goods to a dealer in Bombay or Calcutta, who took them to the exchange banks, and obtained the price at an exchange of 1s. 4d. to the rupee, whereas, under the old system, he would have obtained an exchange of 1s. for the rupee. That was a difference to the man who sold his goods in India of fully 30 or 40 per cent. on the value of his production; and it was estimated by competent people that India lost, in that way alone, twenty millions a year in the value of her exported produce. Every industry in the country was suffering at the present moment, including the manufacturers of cotton goods, and the producers of tea, coffee, and all agricultural produce. He might be asked, What alternative would he have suggested had not the present system been carried into operation? The alternative he had always urged was to leave the matter alone. The author had enlarged on the tremendous fall which had taken place in the price of silver during the last ten or fifteen years. The fall would not have been nearly so great, but for the blow struck by the Government of India at the value of silver all over the world. Prosperity had attended the people of the Straits Settlements, who had been using free silver all the time, bnt nothing of the kind had taken place in India. Would it not be a great benefit to the people of India at large if the free silver system again came back? It might be said that this could not happen because the Government of India would become bankrupt. The alternative would have been for the Government of this country to raise a loan to carry India through the crisis in the fall of the value of silver. He thought silver would have been maintained at a level of close upon 1s. if the change had not been made in India. It would have adjusted itself, and prices would have remained at a common level. It would have been easy for the Government of this country to raise a loan of twenty millions to carry India through this great economic crisis England gave millions to Ireland and the Transvaal, but would not give a single sixpence to India, which was infinitely more valuable than any other possession of the British Crown. The system described had worked very badly for India, and that state of things would go on from year to year uutil the Government was at last forced to come to Parliament and tell them that things had become so bad that a remedy must be applied by the Imperial Parliament.

Mr. J. D. Rees, C.I.E., thought the difficulties of the problem lay in the fact that a state of affairs existed in India which did not exist anywhere else— a government and a mercantile class who were not permanently settled in the country, so that it did not follow so immediately as might appear, that what was good for the one was good for the other. To that extent he agreed with Mr. Maclean. But when Mr. Maclean said that he could not applaud the Indian Government on the policy they had adopted, he believed Mr. Maclean had never applauded the Government of India on any policy, and that rather detracted from the impartiality of his interesting speech. There were many of Mr. Maclean's allies present who did not go so far as he did in their views. He (Mr. Rees) was a very careful student of the Indian vernacular press, which did not approve of the currency policy, but it did not go so far as to say that if the Government was in desperate straits, as Mr. Maclean admitted they were, they were to go on into more desperate straits and bankruptcy rather than alter matters. The vernacular press stopped short at that, and said the the Government after all was the best Government India had ever had, and that they would prefer to see it take any step rather than reach such straits as might lead to its being supplanted by any other. Mr. Maclean must allow that the Government were bound to take some step, and they apparently took the only possible step, with very considerable success. It had also been argued by Mr. Maclean that the Government of India had prospered greatly before the new policy was brought into force. He did not know what proof Mr. Maclean had for that statement. It seemed to him that India at all times, as was the case with all agricultural countries, was in some respects in a parlous condition. When was there a time when agriculture prospered? Before the introduction of the new system, India was in a bad way, and it had been in a bad way since, so far as the partial failure of the seasons went. But if the value of the exports and im-

ports was a proof of prosperity—and it was a great proof—surely the imports and exports of India were greater now than they were in the earlier period, the prosperity of which Mr. Maclean brought forward as a proof that the country had deteriorated since the present policy was adopted. Mr. Maclean had suggested that the Government of England should raise a loan to carry the Government of India through the crisis; but it would have been absolutely impossible to propose such a thing in the House of Commons, with the slightest chance of success. Nobody knew how long the crisis would have lasted, and, in the meantime, the home charges, to which he objected because they impaired the value of English rule, would have mounted up to so large an amount that the Government could never have paid it. While he believed Mr. Maclean's remedy was impossible of adoption, he hoped the day would come when India would be considered to have as good a claim on England as Africa, on which millions were lavished. Turning to the paper, the author said the currency policy was the cause of the present prosperous budgets. It seemed to him that that was as arbitrary a statement on one side as any of Mr. Maclean's on the other. The budgets must depend upon the condition of the country; they could not depend chiefly upon currency. The author also said that India had a gold currency. It seemed to him (Mr. Rees) that one could no more argue that India had a gold currency than a man could argue that he had a pocketfull of gold because he had a banknote in his pocket. It could hardly be that India was as well off now as if it had all the gold which the currency was supposed to represent. The author had also made mutually destructive statements about the effect of the currency policy upon agriculturists. In one part of his paper he said that that policy had not affected the agriculturist, and in another place he said that it had deprived agriculturists of an advantage of 45 per cent. in prices. One or other position must be wrong. Mr. Robertson had stated that the depression in the tea and coffee industry was entirely the result of over-production. No doubt that was so, to a large extent, but if, as used to be case, the planter got 1,800 rupees for a ton of coffee, instead of the 1,500 rupees he now obtained, he surely had 300 more rupees for every ton of coffee with which to pay for the labour. He remembered that Mr. Jacob explained that gold prices would rise when the new policy was adopted, but the contrary had happened. Sir Robert Giffen also had said that it might take a very long time to produce the equilibrium, and he did not see any signs of it yet. It seemed clear to him that the planter in India suffered a very great loss through the currency policy; but that did not apply to the great masses of the people. There was no proof that the people of India were any worse off than they were before. The effects of the policy were chiefly confined to the Government, the importer, and the exporter. They gained by it, no doubt, very largely, but he did not see where the people of India would gain by it, except so far as their interests were identical with those of the Government and the mercantile classes, nor could he see that they had been prejudiced, the purchasing power of the rupee not having changed. He hoped it would be borne in mind on all sides that the Indian agriculturist was a poor man, and that the less taxes taken from him the better. He thought the military budget should be considered in very much the same way as the military budget was being considered in the House of Commons, and the fact should be admitted that what was required for the protection of India was not to put heavy guns in all sorts of inaccessible places, where nobody was coming to face them, but to keep a powerful navy in command of the sea.

Sir JAMES WESTLAND, K.C.S.I., after congratulating the author on his exceedingly interesting survey, said he was present at a meeting some time ago, when the author of a paper seemed to fasten the blame of everything of an evil nature which had taken place upon the Government. The evils of every kind which had occurred in the coffee and tea plantations were put down as the results of the currency policy. The subject was a very difficult one, because it entered into the commonest concerns of the people, and it was impossible to carry into effect an operation of the kind described affecting 300 millions of people without inconveniencing somebody. He agreed with Mr. Rees's proposition that they did not always expect the operations decided on by the House of Commons to be carried out without some inconvenience; in fact, people in India did not expect anything from the House of Commons. The House of Commons was far more anxious to throw part of its burdens upon India than to relieve India of its burdens. He remembered a particular occasion when the House refused to help India, and when the newspapers criticised them most severely for declining to assist in straits, which it was believed were due to Imperial policy, and not merely Indian. He was entitled to hold his own opinions, and they were not in conformity with those of the House of Commons. One fact must be borne in mind throughout the whole controversy, namely, that the policy adopted by the Government of India had been successful. There was good reason to hope that the budget this year would involve a large remission of taxes, which he thought was a very good standard by which to judge as to the unwillingness of people to believe that the Government of India was doing any good.

Mr. A. R. BONUS, I.C.S., said the question had been raised as to how the Indian currency policy had affected the agriculturist. He thought there was one possible explanation which was fairly simple. Given production going on at the same rate, and given rents fixed for periods of 30 years together, and a contraction of the circulating medium, it seemed to him to follow that in order to obtain any particular number

of rupees wherewith to pay rent, the producer must give a larger share of produce to obtain those rupees. Thus the rise of the rupee from 15d. to 16d., a rise of a little over 6 per cent., had caused a corresponding rise in nominally unchanged rents. Something had been said as to the suffering of the tea and coffee planters, and the reduced prices they obtained for their commodities. There seemed to be an idea abroad that Indian currency legislation had had the effect of driving out the produce of India in favour of the produce of countries like China and Brazil. Before it could be argued that the policy had driven out any particular commodity from a market, one had to prove that that commodity would have been able to hold its own if such legislation had never been undertaken. Taking into consideration not only the various prices which had ruled for Indian coffee, but the amount of extra taxation which would have followed from the mints remaining continually open, he thought it was apparent that free silver in India would not have enabled Indian coffee to undersell Brazilian coffee in London. In regard to the suggestion made that a planter now got only (say) 1,500 rupees for a given amount of tea in place of the (say) 1,800 rupees which he would get if the mints were open, it seemed to him that the purchasing power obtained was exactly the same, only it was expressed in rupees of a different value. The assertion that if a man obtained twenty rupees for a sovereign he was better off than if he had obtained fifteen, might be applied with equal force to an argument in regard to the degrees on a thermometer, that if one adopted the Centigrade in England, and boiled water at 100°, one would be better off in the way of saving fuel than if one heated the water to 212° F. In regard to the alleged loss imposed on the natives by the depreciation in the value of ornament, when the mints were closed in June, 1893, the price of bar silver in Bombay was 106¼ rupees for 100 *tolas*; consequently it was absolutely a loss for a man to take his ornaments to the mint, and turn them into coin. Taking cost of minting into consideration, the same assertion held good for July and August, 1893, when bar silver was worth over Rs. 99 for 100 *tolas*. If thereafter the value of the silver-ornament owner's holding depreciated, that was not the fault of the Indian Government but of the wholesale producers of silver.

Mr. CORNELIUS ROZENRAAD said that having been associated with currency questions, especially in connection with Italy, he was of the opinion that the Indian Government could not have done otherwise than adopt the measures mentioned in the paper. If India had not followed that course she would have been in the same position as China, Mexico, and other countries, and have had a changing currency. The currency then would have depended on the price of silver, which had fallen very much lately. The price of silver was now 22½, so that it would have been an immense loss to the country if the situation had not been changed. If the system adopted was not advantageous, how was it that China, Mexico, and the United States intended to take action by having an International Conference for improving the present situation? He believed it was essential for a country to have a stable currency. He agreed with Mr. Maclean's remarks in regard to the excellent banking and currency system of this country, and if it had been applied in India before 1893, none of the losses mentioned in regard to the variations of exchange that had taken place would have occurred. It would be found in future that all countries would have to come to a gold standard, even China and the Straits Settlements, and he did not believe there would be the slightest difficulty in carrying the system through. He had seen that done in Italy, where they had to give to the Government 29 millions sterling, eight in silver and the remainder in gold, and they were able to give more gold to the Government than was contracted for. Since then Russia and Japan had taken the same step without causing any disturbances on the money market. There never was, and probably never will be any scarcity of gold. In any case, the production of gold is increasing, and the many issue banks have large stocks of gold.

Mr. ROBERTSON, in reply, said that in the paper he had dealt solely with the question of currency; he had not dealt with any of the other burning Indian questions in which other speakers had shown their interest. Many of the objections raised were not applicable to anything he had said, but to the fact that people complained that trade and industries were bad. If mere complaint was taken as the test of a mistaken policy, then no country had anything but mistaken policies. Mr. Maclean brought forward some points in regard to the fall in the value of silver, but, on the other hand, left out of sight the crux of the entire question, namely, that silver in India and in London purchased as much of the average commodities of the world for the 20 years from 1873 to 1892 as it did in 1873, and the change which was imputed to silver by Mr. Maclean was in reality entirely due to gold. Gold prices last year were 31 per cent. below the average of the years 1867-77. He had shown that Indian average prices at Calcutta were, in the last nine years, exactly 2 per cent. higher than they were in 1873. He, therefore, called the rupee system one of stability, and the gold system one of instability. He called the rupee system for the last 30 years an admirable system, because it gave stable average prices, which did justice between the producer and consumer. The English system, which put prices down 31 per cent. because there was not enough gold in the country or in the world to keep the prices up to 100 per cent., was a very bad system. He cared nothing whether it was automatic or non-automatic, so long as it was a practical system; what was required in currency, was a system which would distribute the products of the world at

stable prices, and thus do justice as between producer and consumer, debtor and creditor.

Mr. MACLEAN said that prices had fallen because production had so enormously increased; the products of the world were infinitely greater than they were 20 years ago.

Mr. ROBERTSON said that on the point Mr. Maclean had raised, he could only say that the prices of the articles dealt with in the average prices of imports and exports were nearly all practically raw materials, the consequence being that they had changed very little in cost of production. The point was that in India there had been a stable amount of money for 30 years, and stable prices. In England there had been a considerably reduced volume of money in circulation, and a corresponding fall in prices. It was impossible to deal with more than a limited number of points in the paper, but it could easily be shown that in the ten years, from 1877 to 1886, England lost 35,000,000 sterling in gold, about one-third of its whole currency, and average prices went down to 70 instead of a 100. Mr. Maclean had contended that that was due to the fall in silver, but a fall in gold prices could only be due to causes affecting gold, and they had fallen, as was shown, to the scarcity of gold. The figures he (Mr. Robertson) had produced showed that Indian prices had been kept up to the same level for the last 30 years; in 1873 the figure was 100, and in the last ten years 102. He called that a good system of currency which distributed the products of India on a just basis; it did not decide whether the price of any one article should be higher or lower, but it decided that the volume of money in circulation should give comparative stability in the average prices of the leading commodities, and thus be a standard which did justice. Coming to gold prices, when a standard existed that caused a fall in prices of 30 per cent. owing to the scarcity of gold, he called that a bad system. Mr. Maclean had complained that the reason why the officials were injured was because the gold value of silver was falling, and consequently the gold value of the exchange; the officials thus naturally complained because they were very severely prejudiced in their incomes. That was exactly the point, gold was so scarce that gold prices could not be maintained up to their former level, and while silver was comparatively stationary in purchasing power, the gold rate of exchange fell, and did great injustice to officials and many other classes. Turning to the points raised by Mr. Rees, it was perfectly true that if there had been open mints the prices would have been 45 per cent. higher than they were to-day, but the question he asked in the paper was, were the people of India interested, by inflating the currency, in finding prices 45 per cent. higher, and the exchange at 11d., or were they interested in a rate of exchange of 1s. 4d., which, in the last ten years, had given the same prices as were ruling in 1875? Mr. Rees stated that in the paper it was alleged that the agriculturist had not been affected by the currency policy, and in another part that the agriculturist had by it been deprived of a rise of 45 per cent. in prices. But the 45 per cent. would have been the result of an inflated currency which would have done great injustice to the other classes in India, and would have been from the the economic view, a serious blunder in policy. He maintained that the ideal system of money was one which produced stability in the average prices of commodities, and India had had a high degree of stability. No country in the world could show such stability in general prices as India had shown in the last 30 years, and these stable prices have enabled all classes to pay their taxes and thus contribute to satisfactory budgets. But the stability of average prices settled nothing about individual prices. The Government could not say that cotton or tea or jute or any other article would be at this, that, or the other price; but they provided a basis of currency which maintained the average prices of commodities steady; while one price might be 20 per cent. higher and another 10 per cent. lower and so on over the whole list of leading articles. His contention was that India was not interested in prices being raised to the extent of 45 per cent., which they would have been if the mints had been opened; as certain classes would then have benefited at the expense of the rest. As to whether one article would be high or low, no currency system could determine that; demand and supply must fix the conditions under which the prices of individual articles were regulated. He contended that the desideratum for which the economists of the world were striving to-day was a system which showed a large body of commodities at a steady level of average price, and India had shown this more than any other country.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Robertson for his valuable paper.

Mr. W. MARTIN WOOD writes:—As Sir Edward Sassoon indicated, no appreciation would be too high as to the value of Mr. Barr Robertson's paper considered as a statistical survey, at once thorough and discriminating. The trend of its argument is a different matter; and his conclusions have to be tested in the light of certain Indian conditions, the relative weight and bearing of which no available statistics suffice to describe. His materials are on the surface; and in respect of those interests that are seen, those represented by European firms in the Presidency cities, the Anglo-Indian exchange banks, and, above all, the smooth presentation of the India Office accounts, his case for the "regulated," *i.e.* restricted, currency, whereby "stable-exchange" is so far secured, was, as the Chairman admitted, complete. But though the "cost of exchange" has been swept off the Financial Statement, it is not extinguished: it has gone somewhere. Its record is kept in those inexorable figures of the excess of exports in the trade returns

(about Rx. 28,000,000 for the year just closing); but this huge factor, the bed-rock of the whole subject, was nowhere dwelt upon in Mr. Robertson's paper, being only incidentally used so far as needed as an element in his argument on what-is-seen. That cost, formerly borne by the Indian revenues as a whole, has, by this peculiarly ingenious scheme of currency-doctoring, been forced on the producers of non-edible exports—mainly 100,000 000 of the most impecunious of the Indian community, the cultivators. The instructions to the Fowler Committee of 1898 included the essential direction to consider "the probable effect of any proposed charges upon the *internal* trade and *taxation* of that country" —India. Much evidence was offered to the committee; but it disappeared from the report, which had to register its predestined conclusion. In his section on "Agricultural Prices and Wages," Mr. Robertson made a valiant effort to get round "the effect" of these "charges upon the *intended* trade and taxation" of India. But the argument is vitiated by the inclusion of food-grain and wages. These have had only indirect connection with the effects of restricted currency and the artificial "stable exchange" As to rates of wages, that does not count, as in India that is ruled by the lowest cost of the labourer's subsistence. As to prices of food grain, these during the later years of the "experiment" have been "regulated" by dearth in fully one-third of rural India on one hand, on the other by its costly transport from prosperous districts, at immense outlay of public funds; therefore, the index prices of edible products, though taken at "several centres," are beside the mark, and nothing to the purpose. With regard to export products, that rests on quite a different basis. Mr. Robertson's strongest point, al through, is the stability of these prices based on the valuations at Calcutta. But it is an obvious fact that these prices—also in somewhat less degree of import from Europe—are ruled by gold prices in Europe, whatever these may be. The prices at the outports have only remote relation to those received by the cultivators in India of the villages, and these have necessarily been depressed by "restricted currency; and will be still more so in proportion as that condition is accentuated in bolstering up 'stable-exchange.'" Later on, Mr. Robertson gave away more than half his case when he admitted, that "had the mints not been closed, there would have been a general rise in prices, in which the cultivator would have gained"; and if the mints were re-opened, "the ryot would have vastly increased prices for his produce." Thus it is avowed that his chance of healthy existence—on which the whole Indian fabric rests—is being cut from under his feet. Here we come near the very crux of the whole monetary problem. One word more. Mr. Robertson makes a strange mistake in saying that India "has the same basis of currency as before 1873," and that it "has now an automatic currency"—whereas it *was* automatic until 1893; but is now "regulated," the plea for which artificial system is the soul and pith of his remarkably skilful, and, for its purpose, valuable essay.

Mr. Alexander Rogers writes:—

Highly approving of the lucid manner in which Mr. Barr Robertson explained the causes that led up to the closing of the mints, and entirely agreeing with him as to the result of steadying the rate of exchange with England at about 16 pence the rupee, I merely desire to say a few words in support of his allegation that this measure has in no way affected for the worse the interests of the industrial classes in India. It has lately become the habit of the Anglo-Indian press, and I regret to say of a portion of the improperly-informed press in this country, to attribute the unfavourable condition of at least three of the leading industries of India, viz., tea, coffee, and indigo, to this cause. The depression in these industries is in fact due to entirely different causes, in the first two to over-production, and in the third to the invention of a chemical dye to take the place of the natural substance. With regard to tea it may be noted that in 1891-92 the area under cultivation was 266,219 acres, and that in ten years, that is, in 1900-1, it was 502,173, or very nearly double. In coffee, notwithstanding the depression of late years, due to falling off in prices, there had been an increase from 127,648 to 133,529 acres. In indigo, too, there was an increase from 541,308 to 984,449. I think these figures are sufficient to show that over-production, and not the rate of exchange, is to be blamed for the existing depression, and that the latter has nothing whatever to do with it. This fallacy has been adopted by many simply from a misunderstanding of the functions of exchange. Exchange is merely the method adopted for remitting money from one country to another by means of paper credit without the expense of sending coin or bullion. Before the Indian mints were closed, and the rate of exchange steadied down to 1s. 4d. the rupee, a great deal of the trade between India and England was simply a gambling transaction, for when the value of silver, as compared with gold, was falling at an uncertain rate, there was no knowing, for even a short time, what the rate of exchange would be at a certain time. If the steadying of the rate of exchange has done no other benefit to India, it has certainly put an end to this state of affairs, and established trade on a firm and legitimate basis. Now, as the prices of commodities produced in India are in no way affected by the rate at which money is remitted from one country to another, what are they regulated by? In commodities consumable in the country by the ordinary laws of local demand and supply, and in exportable products by the demand and supply of the world. It has been said that, because 16 pence is a fictitious value, far too high to put upon the rupee for exchange purposes, the effect is to lower the price of Indian commodities. But the rupee is a different thing when it merely serves the

purpose of internal commerce, and when it is used for remittance to gold-using countries, and weighed against gold. In the latter its value is regulated by the relative values of gold and silver, and in this respect the Government of India has arranged, as it had every right to do, that it shall be reckoned at the rate of 16 pence the rupee. With regard to the former function the value of the rupee has in no way been interfered with, and it remains, therefore, in India, the standard of value for all internal transactions that it always was. That in consequence of the value of silver falling it has become a mere token coin (just as the silver and copper coinage of England has become) makes no difference as long as it is used in India. What would be the result of refixing the present stable rate of exchange and letting it follow the fall of silver as compared with gold? People bringing gold to India would get Rx. 30 for their sovereign instead of 15, but the rate of exchange for remittance of money to meet the home charges would fall proportionately, and the people of India would have to be taxed to the amount of probably 6,000,000 more—India would, in short, be bankrupt. Rather than this, I would allow the merchant who complains that in bringing the profits of his trade with China and Japan to India he loses by the fixed rates of exchange, shift for himself. It would not matter to India. Mr. Jamsatjee N. Wadia, of Bombay, has gone so far in this matter as to accuse the Government of India of indirectly levying in rent of land and taxes 30 per cent. more than it ought, and asking whether 1,000 *tolas* of silver would be taken by its officers for Rx. 1,000. My answer is "Yes, for it actually takes the current rupee, which is equivalent to a *tola*. It does not take the rupee at its gold value." I quite concur with the reader of the paper that the currency policy of the Government of India is the best that could have been adopted under the circumstances.

SIXTEENTH ORDINARY MEETING.

Wednesday, March 25, 1903; PROFESSOR VIVIAN B. LEWES in the chair.

The following candidates were proposed for election as members of the Society:—

Branford, Herbert Mills, F.C.A., 3, Broad-street-buildings, E.C.
Cowen, Charles, 5, Upper Woburn-place, Russell-square, W.C.
Dudley, Plimmon Henry, Ph.D., 80, Pine-street, New York, U.S.A.
Edwards, Charles Augustus, L.R.C.P.E., L.R.C.S., Sydney, New South Wales.
Francis, Arthur A., The English Crown Spelter Co., Ltd., Ponte di Nossa, Bergamo, Italy.
Lowenadler, Fred., 4, Fenchurch-avenue, E.C.
Mallet, Prof. John William, Ph.D., M.D., LL.D., F.R.S., University of Virginia, Charlottesville, Virginia, U.S.A.
Mullins, John Henry, Presnyefa, Cardiff.
Newland, H. Osman, 126, Brixton-road, S.W.
Oki, Yoshinao, Takasima Colliery, Nagasaki, Japan.

The following candidates were balloted for and duly elected members of the Society: —

Aglionby, Captain Arthur Charles, Junior Naval and Military Club, 96, Piccadilly, W.
Chichester, Hon. Mrs. Augustus, 8 Morpeth-mansions, S.W.
Griffin, Henry James, 3, Sach-road, Upper Clapton, N.E.
Guyot, Yves, 95, Rue de Seine, Paris, France.
Heydeman, Harry, A.M.I.Mech.E. (P.O. Box 395), 10, Imperial-buildings, Gardiner-street, Durban, Natal, South Africa.
Longfellow, William Pitt P., 479, Broadway, Cambridge, Massachusetts, U.S.A.
Lopez, E. J., M.I.E.E., Indian Government Telegraph Department, St. John's-hill, Cleveland Town, Bangalore Cantonment, Madras, India.
Maclay, William, Thornwood, Langside, Glasgow, and Corn Exchange-buildings, Glasgow.
Rohlfs, Charles, 198-200, The Terrace, Buffalo, New York, U.S.A.
Sharp, Andrew, A.R.I.B.A., care of Messrs. Darling and Pearson, Leader-lane, Toronto, Canada.
Stark, Leopold, M.I.E.E., care of Messrs. Ganz and Co., Budapest II., Hungary.
Stewart, Charles James, 29, West-hill, Sydenham, S.E.
Sundarlal, Rao Bahadur Syam, C.I.E., Diwan of Kishengarh State, Darbar Office, Kishengarh, Rajputana, India.
Zimmer, George Frederick, Assoc.M.Inst. C.E., 82, Mark-lane, E.C.

The paper read was—

PETROLEUM INCANDESCENT LIGHTING.

By ARTHUR KITSON.

The great advance in the industrial arts which the last quarter of the 19th century witnessed is nowhere exhibited to a greater degree than in the branch of artificial lighting. Thirty years ago the highest development of artificial light was found in the Argand burner, and the best street lamp in general use consisted of an ordinary fish-tail burner consuming about seven feet of gas per hour and giving a light equal to about 15 candle-power. Thirty years ago Charles Brush was experimenting in a small room in Cleveland,

Ohio, with an apparatus for producing light by means of an electric current generated from a dynamo, which was destined to make him both rich and famous. At the same time, Thomas Edison was endeavouring in his laboratory at Menlo Park, New Jersey, to procure a suitable filament for the production of the electric light by incandescence, whilst Hiram (now Sir Hiram) Maxim was working at the same problem, endeavouring to maintain the life of the filament by depositing carbon from the decomposition of a hydro-carbon gas with which the glass globe was previously charged. Elihu Thompson—a name now known universally, not only in connection with electric lighting, but also as the discoverer of electric welding and the pioneer of electric traction—was then a fellow school teacher with Professor Houston (another well-known name in connection with electric lighting) at the Philadelphia High School, wondering whether the electric business afforded sufficient scope to warrant him in giving up his position as school teacher—for which he was then receiving about £200 per annum—and devoting his time to the manufacture of electric machinery for the production of light. Siemens was then working to perfect his regenerative gas lamp, whilst the name of Welsbach was unknown. The only form of incandescent gas lighting known at that time was the platinum gauze mantle of Gillard, who succeeded in producing light from hydrogen and water-gas. At this period acetylene, as an available source of illumination, was unknown, except as a very minor constituent of coal-gas. Practically all the great achievements in artificial lighting have been accomplished during the last thirty years—achievements which transcend all that was previously accomplished in this art during the world's history, of which we have knowledge.

It is only by contrasting the present condition of things with those existing twenty-five or thirty years ago, that one can get any adequate conception of the stupendous achievements made in the industrial arts. Those whose memories fail to carry them back so far can, however, satisfy themselves by comparing the lighting of some of the residential streets in Paddington, Marylebone, and other districts, with the Strand, Piccadilly-circus, or Regent-street on a week night. Notwithstanding the great improvements in the methods of producing light, it is principally upon the commercial localities, the business thoroughfares, that these benefits have been conferred. The masses of the population here and abroad are still using the old oil lamp. It is estimated that ten million oil lamps are lighted in Great Britain every night, and an average of 129 persons die annually from accidents arising from their use. In fact, there are more oil lamps manufactured and sold now than at any former period. The number of oil light consumers still outnumber those of electricity and gas combined to a very large extent. Admitting the vast progress made in gas and electric lighting, in one sense both have stopped short in the fulfilment of their mission. They have not yet come within the reach of the majority of the poorer classes for domestic purposes. Among these the oil lamp still holds its own, for in point of cheapness it surpasses both. I refer, of course, to the ordinary oil lamp having a wick and glass chimney. In the poorest dwellings one or two lamps constitute the entire lighting plant, and obviously it would not pay a gas or electric company to run pipes and wires and put in meters for so small a consumption of light. In fact, the use of the modern gas and electric lamps could not have been even as general as they are but for the growth and distribution of wealth among the middle classes. High candle-power lighting is still a luxury.

In the competition among artificial illuminants it has been interesting to watch the advantages gained first by one system and then by another, until an efficiency has been obtained which even ten years ago would scarcely have been credited. Until quite recently the contest seemed confined to gas and electricity. But within the last six years acetylene has claimed a place in the race, and thanks to the invention of Welsbach, oil has been brought to a position where it is regarded as a serious competitor by its two more popular rivals.

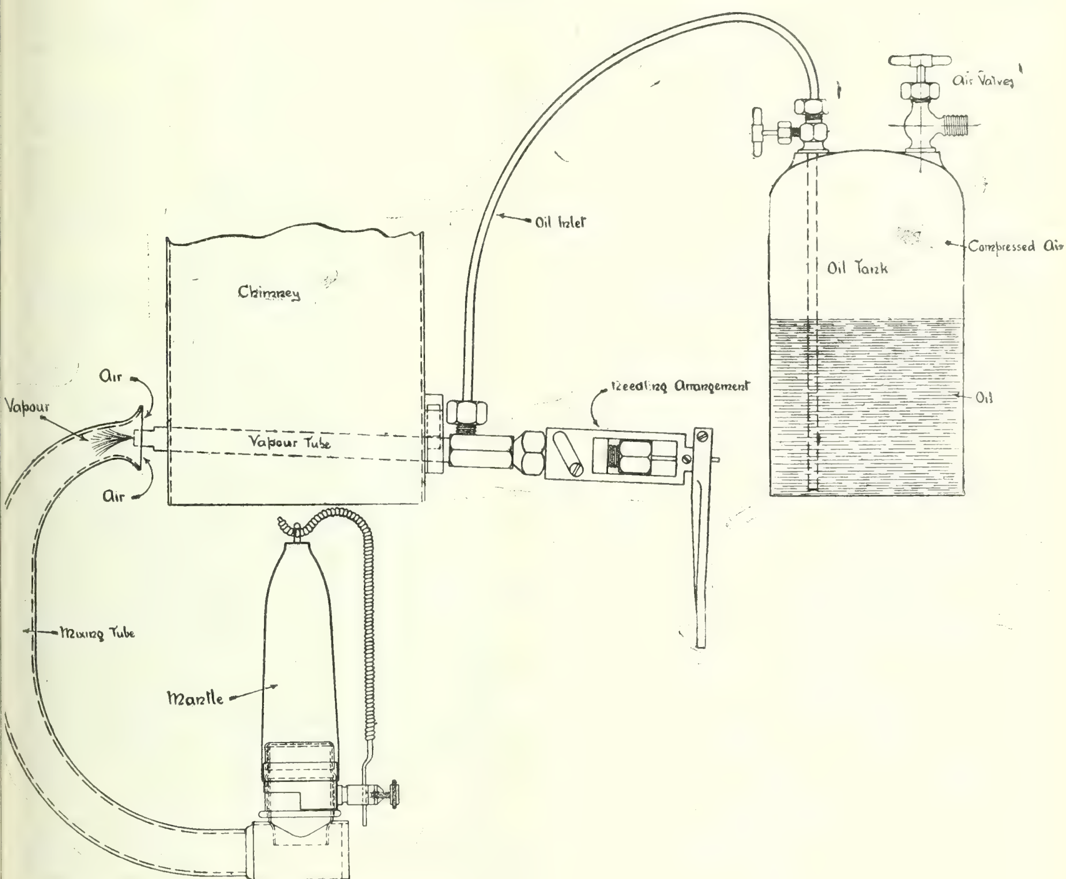
It sometimes happens that in solving one problem the inventor provides the means for solving several others, and in discovering and perfecting the means for improving gas lighting, and placing it on a level with—if not ahead of—electric lighting, Dr. Auer von Welsbach opened the way for improving oil lighting, and bringing it up to a similar level. It was pointed out many years ago by Dr. Frankland and others, that in ordinary gas lighting there was an immense waste of energy — that the amount of heat given off by the ordinary gas flame was out of all proportion to the illumination produced. To remedy

this, various enriching gas lamps were brought out, the object of which was to supply the gas flame with a larger proportion of hydro-carbons (such as the vapours of naphthalene), and so increase the efficiency of the gas flame. It was found that the greatest efficiency was produced by converting the gas completely into a heating flame—on the Bunsen principle —and employing this to heat some suitable refractory material to incandescence. It is interesting to notice the revolution that has occurred in the use of gas for the production of light during the past few years.

More than 15 years ago I called attention in a paper read before the Franklin Institute of Philadelphia, to the fact that a much greater amount of illumination could be obtained from illuminating gas indirectly by transforming its heat energy into electric energy, and so furnishing the electric light, than by burning the gas direct. This efficiency has, however, been vastly increased by the use of the incandescent mantle.

It is but fair to say that had it not been for the discovery by Dr. Auer von Welsbach, of the thorium—cerium mantle, the incandescent petroleum light would probably never have been heard of. In my first experiments, made during the years 1885 to 1887, I used a platinum gauze mantle. This method of producing light I discovered whilst carrying on some experiments connected with the production of a heating flame for oil. I vaporised a heavy oil —having a flash point of about 200°—and mixed it with a current of air obtained from an ordinary Sturtevant blower. The result was a flame of intense heating power. It occurred to me that the application of a platinum gauze

Fig. 1.



Sketch of the Original Kitson Lamp.

mantle would furnish a brilliant light. The experiment proved successful, and I then devised an apparatus which could be used as a lamp where the vaporisation of the oil and the current of air were provided automatically by the operation of the lamp itself, without the use of a blower. The heat necessary for vaporising the oil was readily obtained from the mantle or burner itself, and the principle of the Bunsen burner naturally suggested a method for obtaining the necessary mixture of air and oil vapour.

Fig. 1 represents the original type of lamp. In this the vapour tube was placed horizontally, or nearly so, and just over the mantle. A chimney served to direct the hot products of combustion from the burner, and bring them in contact with the vapour tube. This tube consisted originally of a brass pipe—$\frac{3}{8}$ inch inside diameter, and about 9 inches long. The discharge end was plugged, and in the centre of the plug was an exceedingly fine hole 9-1000ths inch in diameter, out of which the oil vapour escaped. This end projected into the mouth of a bent tube, known as the mixing tube, the other end of which supported the burner and mantle.

In escaping into the mouth (made flaring) of the mixing tube, the vapour jet induced a current of air with which it became intimately mixed in its passage to the burner, where it burned raising the mantle to a high degree of incandescence. The oil was supplied to the vapour tube under pressure, and I found that the intensity of the light was somewhat proportional to this pressure up to about 60 lbs. Beyond that, there was no advantage, and if increased much more, the light was diminished. Another discovery was that the relation of the diameter of the mixing tube to that of the oil vapour jet was an exceedingly important matter, and the lamp would only operate whilst this relation was preserved within certain narrow limits. This of course was due to the fact that the oil vapour would not burn satisfactorily unless the proportion of air to vapour was restricted. Below a certain limit the mantle became smoky—and soon covered with carbon deposit, above a certain limit it would not burn, as the mixture was too weak.

Experiments with the use of platinum soon convinced me that this was totally unsuited for practical purposes, and that if no other material was forthcoming out of which to make mantles, oil incandescent lighting was doomed to failure. Apart from its high cost, a serious disadvantage was that platinum rapidly deteriorated under the influence of carbon compounds in the gas at so high a heat, and the light soon fell off. Sometime later, I procured a Welsbach mantle, one of the original type—which gave that "bilious green" appearance to everything upon which its rays happened to fall. Applying this to the oil flame, I obtained a very brilliant light, not quite so "green" as that furnished by gas, but this lasted only a few moments, when the mantle fell to pieces. Repeated trials all ended in failure, and I was compelled to regard the lamp as merely an interesting laboratory experiment.

Through inability to procure a serviceable mantle I was compelled to lay the experiments on one side, and it was not until the recent improvements in the art of mantle making—due largely to the later discoveries of Dr. Auer von Welsbach—that I was enabled to produce a lamp suitable for public use.

A petroleum incandescent plant consists of (1) a closed tank or reservoir to hold the oil under a pressure of from 40 to 60 lbs.; (2) the lamp, consisting of a burner and mantle, vaporiser and mixer, and (3) the tubing for conveying the oil from the tank to the lamp.

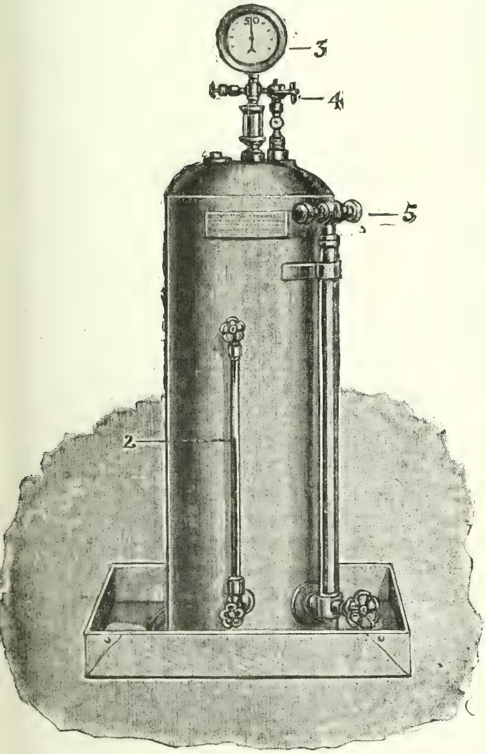
The Tank.—This is preferably seamless (see Fig. 2), and made of sheet steel, pressed out of a single sheet by hydraulic pressure with the bottom turned in and brazed. These tanks —a sample of which is exhibited—are manufactured in the United States, and are remarkable examples of the development of the hydraulic press for metal work. My experiments with containers showed that rivetted tanks were not wholly reliable. Out of one hundred rivetted tanks tested, more than half leaked with an oil pressure of 100 lbs., and 70 per cent. leaked when the pressure was increased to 150 lbs. Each of the seamless tanks is subjected to an oil pressure of 300 lbs. for 24 hours before being put in public use. I need hardly point out the necessity for having this part of the plant equal to all emergencies. So far as I am aware, out of all the thousands of installations in use, not a single instance of leakage of oil from these tanks has been detected.

It may be of interest to many to learn that so far no English firm has been found able to manufacture these tanks at any price approaching that for which they are sold in the United States. One firm in Birmingham has, indeed, made the attempt, and I am hoping they will within a reasonable time succeed in competing with the American company. As a part of the oil plant, the tank is

provided with an oil level gauge, and an oil pump for refilling.

Lamps.—The essential features of the lamp are (1) the vaporiser adapted to receive heat sufficient to vaporise the oil. (2) The mixing tube in which the vapour is mixed with a sufficient amount of air (and no more) to ensure proper combustion. (3) The burner containing the mantle.

FIG. 2.

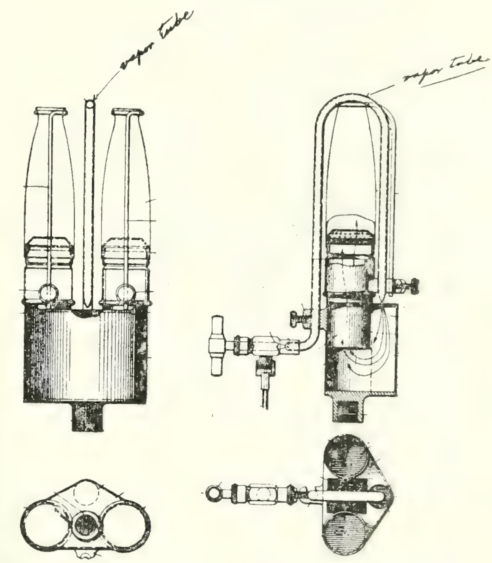


RESERVOIR.

A slight guage (2) indicates the depth of the oil in the tank.
A pressure gauge (3).
A safety valve (4).
A single oil pump (5).

The vaporiser is the most important and troublesome part of the installation. In reality it is a miniature gas works, in which the oil is converted from a liquid to a vaporous or gaseous condition. This process is invariably attended with the deposit of carbon, the amount of the deposit being proportional to the density of the oil and the rate at which it is raised from the atmospheric temperature to the point of vaporisation. The more sudden the operation the greater the deposit. If it were practicable to conduct the oil through a great many feet of piping which increased in temperature at a gradually and regularly increasing rate, so that the molecules had sufficient time to re-arrange themselves, the precipitation of carbon might be reduced to practically an inappreciable amount. Practice forbids this, and the vaporiser is seldom more than one foot in length. The oil is therefore projected at atmospheric temperature into the vaporiser, which is just below a red heat, and the oil is immediately broken up into a series of compounds—some of which are fixed gases and others unstable condensable vapours.

FIG. 3.

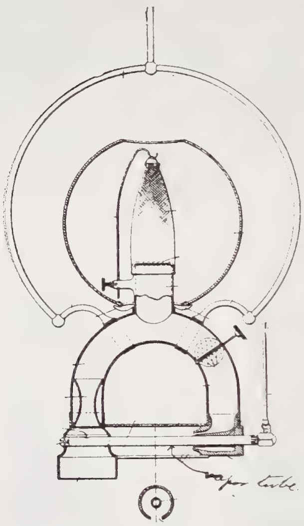


END VIEW AND RAN. SIDE VIEW.

The result of this is a precipitation of carbon which very soon clogs up the vapour tube and chokes the small hole through which the vapour escapes. It is this difficulty which has been the hardest to overcome in making the system commercial. Obviously, a lamp that is liable to extinguish itself after an hour or two's burning is not likely to become popular. In experimenting with a view of overcoming this difficulty I discovered that the carbon collected on the cooler of two surfaces, and I found that by placing a rod or tube in the centre of the vaporiser that the carbon would deposit on this, instead of on the walls of the vaporiser. By taking out this rod occasionally it is a simple matter to clean and replace it. The one essential feature of a successful incandescent oil burner is a vaporiser that can be cleaned or replaced quickly and easily. Another important feature is the lighting of the lamp. Before a lamp of this type is ready for

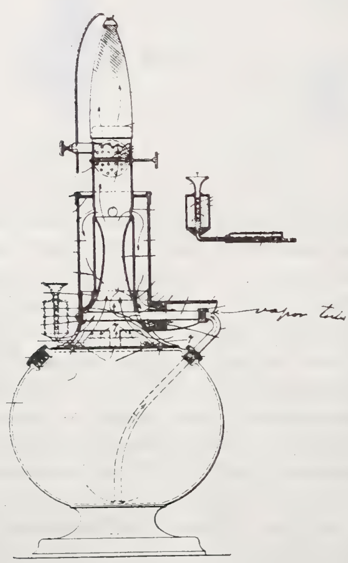
use the vaporiser must be heated to the temperature at which the oil vaporises, and if this operation is very troublesome or takes a long time the system cannot be considered practicable. I have, therefore, made the vaporiser as small as is consistent with the proper supply of vapour and with the walls as thin as is consistent with strength and durability, with the result that our ordinary lamps are lighted in a few seconds. The vaporisers, as we now construct them, require cleaning about once every month, but in some cases they will run as long as three and four months. It is obvious that the vaporiser may be placed in many positions where it will receive the heat of the mantle or the burner, and the following views of different types of lamps will show a variety of ways of placing the vaporiser in connection with the burner. (See sketches, Figs. 3, 4, 5, 6, 7.)

FIG. 4.



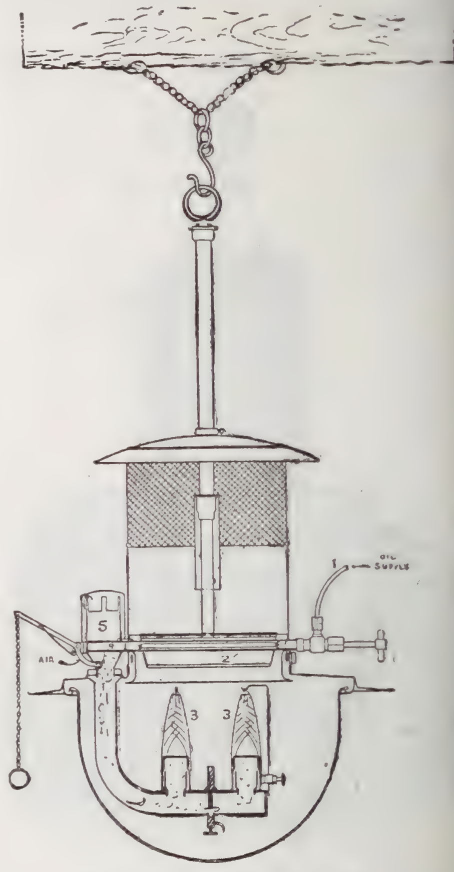
WITH VAPORISER BELOW THE MANTLE.

FIG. 5.



HORIZONTAL VAPOUR TUBE BELOW THE MANTLE.

FIG. 6.



SECTION OF KITSON LAMP.

The oil, reaching the lamp cold, through the tubing (1), is conveyed to a vaporising tube (2), which in diameter is the size of a lead pencil, and eight inches long, and is there gasified by the heat from the mantle (3)—the arrangement being such that only a minute quantity of oil contained in the vaporising tube is subjected to the heat at one time. An indication of the smallness of the consumption is here afforded by the minuteness of the outlet (4) at the opposite end of the vaporising tube, it being no larger than a needle-point. From thence the oil vapour passes into an open mixing tube (5) on the top of the reflector, where sufficient air is drawn in for supporting combustion. The mixture then travels down to the mantle, inside which it burns.

In some cases I placed the vaporiser inside the mantle, sometimes below, sometimes above and at the side.

For lighthouse purposes and photographic work it is advisable to have no over-head obstruction, so that all the rays of the mantle may be effective. For this purpose the vaporiser is placed below the mantle (see Figs. 4, 5 and 6), and is heated by a jet taken from the vaporised oil and air on its way to the burner. In some cases I found it advantageous to use two tubes, one of which was termed a filtering tube, being a tube $\frac{3}{4}$-inch in diameter, and filled with some porous substance, such as pumice stone or coke, which was placed some distance above the vapour tube. This collected a considerable amount of carbon, and saved the vapour tube from clogging for a much longer period.

Tubing.—I have here samples of the tubing which will show through how small an orifice the oil may be supplied sufficient for one or more lamps. The largest tube that we have ever had occasion to use was but 5-16th inch inside diameter. This furnished oil sufficient for over one hundred lamps of 1,000 candle-power each. All the joints in the tubing are carefully brazed except where it joins the vapour tube and tank. Small screwed unions are used at these points. Each tank being provided with a filter composed of cotton waste, silk, gauze, or some similar straining device, there is no chance for any particles to lodge in the tubing and clog it, and I know of only one instance in which after months of use the tubing conveying the oil from the tanks to the lamps became choked, and this happened in a case where the filtering material had been taken out and the *employé* had forgotten to replace it. The oil tubing is generally run in wooden moulding, similar to that used with incandescent electric wiring.

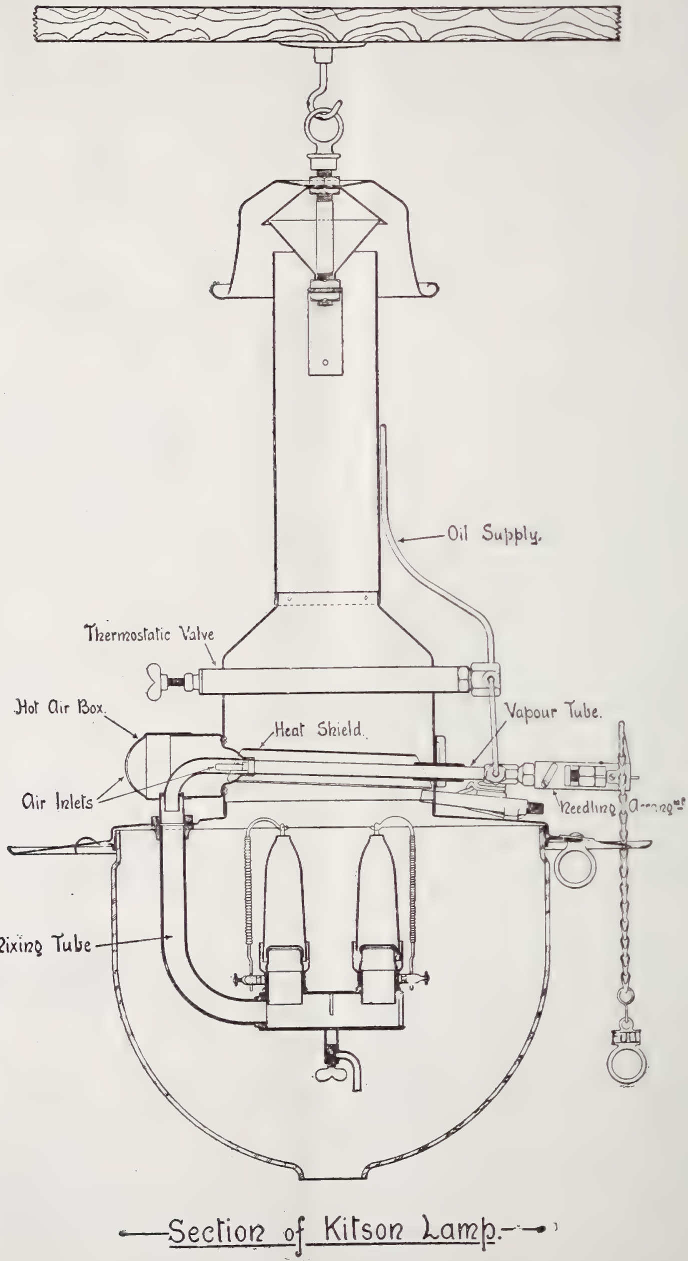
Provision is made on each of the tanks in case of the tubing being fractured or broken by accident. A check valve is placed on each tank and connected with the tubing in such a way that in the event of any sudden flow of oil the check valve, a sample of which is here exhibited, comes into operation and shuts it off.

In the lighting of buildings or open spaces, a number of lamps can be operated from one tank. At the Philadelphia Export Exposition, in 1899, 100 lamps were supplied from one tank. As an illustration in the economy of floor space, it may be interesting to know that a space of ten square feet was all that was required for furnishing light, equivalent to 200,000 candle-power equivalent to 200 horse-power in electric energy. Contrast this with the space required for a gas works, or an electric light plant (with its boilers, engine, dynamo, &c.) to furnish a similar illumination, and it will be seen that, in this respect, at least, the oil incandescent plant is a great economiser. Another feature of the system is that the oil can be carried for a considerable distance by means of pipes. It is, in fact, quite practicable to supply small villages and towns from a central reservoir and to run the oil pipes and tubes into private houses similar to the manner in which water or gas is now supplied.

One other feature of the lamps I may mention, and that is the thermostatic valve, which was designed to prevent a difficulty pointed out by some of the insurance companies. It was objected by some of the surveyors that if the oil was accidentally turned on to the lamp before the vapour tube was properly heated there would be a flow of oil through the vapour tube into the mixing tube which would rapidly fill and overflow into the glass globe, and then the oil would continue to overflow on to the floor and endanger the building. This undoubtedly was a weak feature in our original lamps, but our answer to this objection was that a similar complaint might be made in respect to the use of gas. Suppose a person turned on a gas jet without igniting it and allowed the gas to continue to escape, and some hours later entered the building with a light! This has actually occurred in numbers of instances. Notwithstanding these accidents, the insurance companies have continued to insure buildings in which gas is being used. Moreover, the spilling of oil is readily detected, and this oil can only burn when raised to a considerable temperature. Gas, on the contrary, ignites easily, and a leak is difficult to trace. However, as we determined to make our system beyond criticism on the question of safety, we designed the thermostatic valve. This is placed in the chimney of the lamp, a few inches above the vapour tube, and opens only under the influence of heat. Should the oil be turned on at the tank when the lamp is cold no harm is done, and as the flame for heating the vapour tube is immediately underneath it, it is evident that by the time the thermostatic valve is hot enough to open, the vapour tube is in prime condition for vaporising the oil. Further, in the event of the lamp becoming choked for any reason, the

thermostatic valve would gradually cool, and ultimately shut off the oil, and so prevent the smoking of the mantle.

FIG. 7.



NEW TYPE OF KITSON LAMP.

Whilst speaking on the question of safety, I may state that out of the many thousands of installations that have been made in the United States, this country, and throughout the world, we have yet to hear of a fire originating from the use of my system. In this respect no other method of artificial lighting can compare with it.

There is, among many people, a great

superstition in regard to the use of oil, and we hear continually of the "deadly oil lamp." According to statistics, the total number of deaths from accidents caused by oil lamps during the past eight years is about 129 per annum. This is considerably less than the number of people who die annually from falling down stairs, and yet we do not hear any complaint about the "deadly staircase," and as Dr. Boverton Redwood has stated in his work on "Petroleum," it would be just as reasonable to introduce a measure to stop the building of staircases, as it is for the oil agitators to advocate legislation to prevent the use of certain grades of oil. The danger is not with the oil, but with the cheap and flimsy lamps that are sold, and if the effort of those who are desirous of saving life were directed to improving the method of burning oil and to educating the users of oil lamps in the manipulation of them, much more good would be accomplished. The use of oil is certainly no more dangerous than the use of gas. The oil we use commercially with our system is known as kerosene. It has a flash test of 100° (Abel test), and a gravity of about ·8, so that it comes well within the limits prescribed by the Petroleum Act, and can be used without fear of danger.

There has never been a case of an explosion in the system as used by us since the light was started, and indeed it would be almost impossible to create one.

During the great fire at Coney Island, New York, in the summer of 1898, thirty of our oil tanks were in the hottest part of the fire, and the fittings were melted off, and the tubing and lamps destroyed, but the tanks withstood the heat, and were afterwards refitted and used again.

I have already mentioned several difficulties experienced in perfecting this system of lighting. Not the least was the absence of necessary fittings, valves, &c., for holding oil under pressure. Take, for instance, the question of valves. After canvassing the manufacturing cities of the United States and Europe, we found we could not obtain a single valve small enough to adjust the supply of oil. The result was we were compelled to design our own valves, and, in fact, every detail connected with the system. As evidence of the numerous new devices connected with this system I may mention that in the United States alone it required 80 separate patents to protect the inventions.

Ignition Methods.—One feature of the system is the necessity for pre-heating the vapour tube before turning on the oil. Naturally, if the oil is admitted to the vapour tube before it is raised to the temperature of vaporisation, the oil will issue from the vapour tube and very soon fill up the mixing tube, and it would be impossible to produce any illumination in this way. Various plans have been tried for accomplishing this pre-heating. One is the application of an ordinary plumber's torch. Another plan is to connect the oil lamp to the gas piping, where gas is already introduced into buildings, and to use the gas in the form of a Bunsen burner which is placed immediately at the side of or below the vapour tube.

In the United States, three-fourths of the lamps in use are lighted by this method, as there are few buildings in the large cities unprovided with gas. Another method involves the use of a carburetter—that is, a closed vessel filled with some absorbant, cotton waste, wool, or some material saturated from time to time with a light oil, such as petroleum ether. By connecting this with the reservoir, a current of air is forced through the carburetter, and produces what is popularly known as "air gas." This is conveyed to the Bunsen underneath the vapour tube, and acts precisely as the ordinary gas flame. By this system any number of lamps may be started at once. For convenience we arrange a switch board at any suitable point, and arrange the oil and air gas valves in conjunction with a sparking coil. The air gas is then turned on at the switch board, and a spark from the battery immediately ignites it in each of the lamps. At the end of a few seconds the oil is turned on, and the lamps are in operation. This system makes the ignition as simple as that of ordinary gas.

Still another method is the application of an electric heating device. Some years ago I arranged a platinum wire in the vaporiser itself, and connected it to an electric lighting wire. The heat of the platinum wire was sufficient to vaporise the oil as soon as it was turned into the vapour tube. The latter method is only applicable where a current of considerable strength is procurable.

Other plans have also been tried, such as the use of the ordinary wick oil lamp for heating the vapour tube. But the simplest method is the gas or carburetter system. One of the earliest methods of starting the lamp was to use methylated spirit or wood alcohol. A small cup filled with asbestos fibre was placed in contact with or immediately below the vapour

tube saturated with spirit, which was ignited, and in this way the lamp was started. In the street lamp the base of the post contains the oil tank, together with the battery and sparking coil for starting the lamp, and the tubing runs up through the centre of the post. (See Fig. 8.) A good deal of discussion has

FIG 8.

KITSON STREET LAMP.

ensued over the introduction of this type of lamp for street lighting.

I have dealt principally with the one type of lamp, namely, the high candle-power lamp for the lighting of large buildings, but it is obvious that the system lends itself to many uses. In one particular department it promises to supersede all other known illuminants. I refer to lighthouse illumination. In 1897, Captain Millis, of the United States Navy, called my attention to the value that the light should have for lighthouse purposes, and at his request I sent him one of our small lamps for experimental work His report was that with certain modifications and adaptations the light would be invaluable for lighthouses and signalling work. Some time later we erected a lamp on Governor's Island, New York, and we have a most enthusiastic testimonial from Lieut.-Col Riley, who was then in charge of the Island as to the value of this light to the ferry boats crossing from New York to Brooklyn, particularly during foggy weather.

In the same year, Mr. John R. Wigham M.R.I.A., of Dublin, (well known in the construction of lighthouse lamps), requested permission to experiment with my lamp for lighthouse work, and in November, 1900, he read a paper before the Royal Society of Dublin, on "The Application of Kitson Light to Lighthouses."

He also called the attention of the enginee of the Trinity House to my system. At the request of Mr. Matthews, of the Trinity House I furnished him with several lamps, and he commenced a series of experiments for adapting the light to lighthouses.

About eighteen months ago, I supplied the Trinity House with a lamp which was introduced into the Lowestoft high lighthouse This lamp had an overhead vapour tube, and was provided with one two-inch mantle. The results of this experiment were most encouraging According to the report of Mr. Matthews, with a consumption of about one-third the quantity of oil previously used with oil wick lamps, a candle-power nearly three times as great was obtained. The experiment was witnessed by Admiral Stewart, Sir Ralph Kno (formerly of the War Office), and Mr. Matthews A distinct shadow was thrown on Gorleston Pier, a distance of eight miles from the lighthouse. In this lamp our ordinary small vapour tube and the commercial oil were used The wick lamps burn a heavier oil, and as this is a much cheaper product than the lighter oil, it becomes advantageous to adapt the lamp to the use of the heavy oil. Mr Matthews therefore commenced experimenting with larger vapour tubes with a view to using the heavy oil, and both the Lowestoft high lighthouse and the new Beachy Head lighthouse are now equipped with these lamps

A 2-inch mantle is employed, and an actual candle-power of 1,400 has been obtained direct, without the aid of a reflector.

One of these lamps, I am informed, will be

FIG. 9.

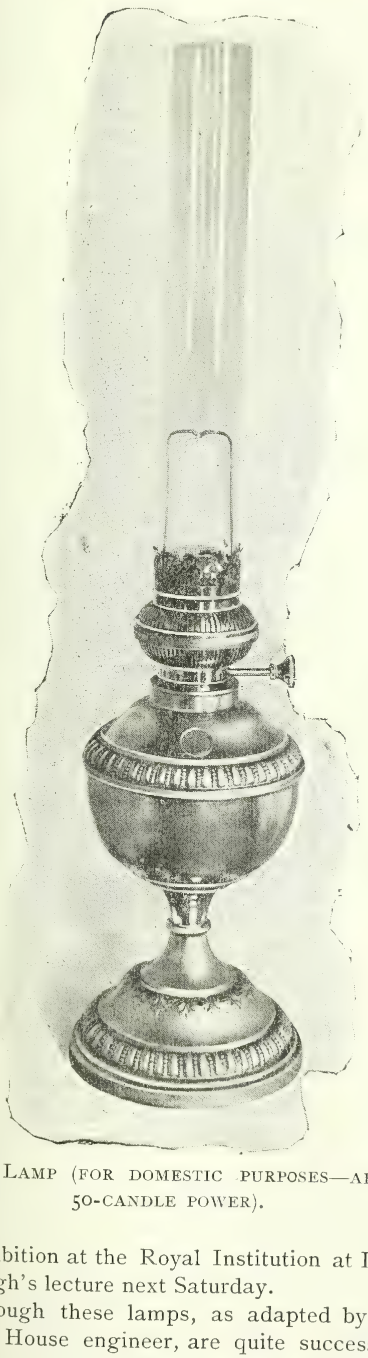


TABLE LAMP (FOR DOMESTIC PURPOSES—ABOUT 50-CANDLE POWER).

on exhibition at the Royal Institution at Lord Rayleigh's lecture next Saturday.

Although these lamps, as adapted by the Trinity House engineer, are quite successful, I do not consider them by any means perfect. One of the main disadvantages is the obstruction of the light by the overhead vapour tube. I have, therefore, adapted one of the type having the vaporiser below the mantle.

One modification of this type is also being tried by Messrs. Chance Brothers, of Birmingham.

Another field in which the lamps promise important development is that of photography. Several views are now thrown on the screen. The North-Eastern Marine Engineering Works were photographed at night at eight o'clock on November 21st, 1900. You will notice how perfectly distinct everything appears. My private office was photographed two or three weeks ago, which is also represented.

Another field is in the direction of searchlights.

For heliographs it is particularly useful. Comprising a small reservoir, reflector, box of mantles, &c., a complete plant can be strapped on a man's back and easily carried. At present the electric light is used for this purpose, and an outfit which is both heavy and cumbersome involves considerable difficulty for its transportation.

Another type of lamp is known as the contractors' lamp, which is adapted for out-door work, railway construction, buildings, &c. This is transportable, two men being able to carry it readily. Hundreds of these lamps are now in use in the construction of docks, piers, &c., and it seems to be rapidly taking the place of the "Lucigen" type of lamp.

Another form is the domestic lamp. (Fig. 9.) In this the reservoir forms a necessary part of the lamp proper. It is provided with a vaporiser, mantle-holder, supply tube which runs into the reservoir and the oil vessel itself. I have one or two samples of this type of lamp here on exhibition.

It will be seen that every lamp outfit is a complete installation in itself. There is no central station, and it is possible to illuminate the streets without resorting to the nuisance of tearing up roads and interfering with traffic.

ADVANTAGES OF THIS SYSTEM.

The advantages of the incandescent oil light are :

1st. The absence of unconsumed products of combustion.

2nd. Its great economy. It is found that the average consumption of oil (gravity 8-10) per thousand actual candle-power per hour is about 1-12th of a gallon. Naturally the relation of candle-power to consumption of oil depends on the quality of the oil, and varies

with the gravity—the lighter the oil the greater the consumption of candle-power, and *vice versâ*. The following is a comparison of candle-power cost furnished from different sources:—

COST OF THE KITSON INCANDESCENT OIL LIGHT.

Description of Light.	Illuminating Power Standard Candles, Average.	Consumption of Gas per hour in Cubic Feet.	Cost per 1,000 Candles per hour in Pence.
Petroleum (Wick Lamps)....	32	—	12·5
Electric Incandescent	15	—	15·2
Electric Arc	1,000	—	3·5
Fishtail (Gas).............	15	5·0	12·5
Argand (Gas)..............	25	8·8	10
Regenerative (Gas)	430	81·0	6·6
Welsbach (Gas)...........	50	3·9	3·2
High Pressure (Gas)........	275	11·0	1·6
Kitson	1,000	—	·8

It will be seen that this system of consuming oil is far cheaper than the old system where a wick was employed.

3rd. The colour of the light: it has been remarked that the colour of the light more nearly approaches sunlight, and it enables one to detect different shades of colour better than by any other artificial illuminant.

4th. For the amount of light, the volume of deleterious products are less than that from the old oil lamps or gas.

5th. The small amount of floor space required.

There is one other type of incandescent oil lamp which remains to be explained. This is a sort of combination of the old type and the new. A wick is used for the purpose of drawing the oil to the burner. The burner ring is in close contact with the wick, and, becoming heated, causes the oil in the wick to become vaporised. By the use of a long chimney a draught is obtained, so that enough air is taken in to mix with the oil vapour to make a blue flame which will raise a mantle to a considerable degree of incandescence without smoking. This type of lamp is useful where a small candle-power not exceeding 50 is required.

The disadvantages are that it is easily extinguished, and it is quite unsuited to open spaces or where there is much air in circulation.

It is only within the last few years that public lighting has been recognised as one of the greatest agencies for the protection of life and property. Some years ago I was present at a Council meeting in the city of Philadelphia, when the report of the Chief of Police was read, in which he stated that the percentage of crime had been greatly reduced since the introduction of the high candle-power street lamps, and he maintained that the greatest assistance to the police was well-lighted streets, and a much smaller force would suffice to maintain public safety if all the streets were properly lighted. I commend this to the attention of the members of municipal councils in London.

A visitor from the United States or from the Continent cannot fail to be amazed at the darkness of the majority of the London streets. Although the leading thoroughfares are fairly well lighted, the vast majority of the residential streets, such as those in Paddington and Marylebone, are as badly lighted as they were thirty years ago. When the Kitson lights were first introduced into Portland-place (which, as you know, is one of the widest and finest thoroughfares in London), one of the residents stated the former lighting was so bad that he was unable to discover the whereabouts of his hat, which was blown off in a wind storm in the month of November!

As to the best method for lighting streets: I do not wish to make any invidious comparisons, but outside of the question of a good, reliable, effective, and brilliant light, that of the method of installation is a serious one.

Any system that requires periodically the tearing up of streets must necessarily be a costly one for a city like London, with its narrow thoroughfares and enormous traffic. What the cost has been to London during the past three or four years it will be impossible to estimate; but the actual expense involved in tearing up the streets and laying mains must be a mere fraction of that entailed on business by reason of the stoppage of traffic.

The oil system offers a solution of this difficulty since it presents a method for supplying each lamp with its own illuminating material. It further meets one objection to central plant lighting, namely, that interference with the plant or with the mains is likely to put the whole district in darkness. This, as you are aware, has occurred in London over and over again. Miles of streets have been thrown into darkness by reason of a fire or accident at the central station. It is needless to say that this could not possibly arise if the system which

I have described was in general use. It has been estimated that the streets of London could be lighted by the incandescent oil system for less money than it now costs annually for tearing up its roads and interfering with the traffic.

We have been asked repeatedly why we have not a larger number of street lamps burning in this country. The answer is, the slowness of this country to take up new things, particularly municipal councils. Only those who have had experience in such matters can realise the enormous amount of inertia existing in English public bodies. It takes a generation to overcome prejudice against what are termed "novelties."

In public improvements, more especially in London, we are fully a generation behind those of Continental and leading Trans-Atlantic cities. Further, in nearly all municipal bodies there is a considerable amount of self-interest displayed. A director of a water or lighting company finds he can protect his company's interests by getting elected to the Borough Council, and I presume there is scarcely a municipal body in England that does not contain a representative of some public supply company; and when proposals from rival systems are made these gentlemen are prepared to fight them. I mention this because it explains to a very large extent what the public do not seem to appreciate, viz., the difficulty of introducing municipal improvements.

I now throw on the screen views of various thoroughfares lighted by this system.

With regard to Portland-place (Fig. 10), I may mention, as an illustration of the cheapness of the light, that twelve of these lamps have displaced sixty-eight of the ordinary street gas lamps, and that twelve oil lamps illuminate the thoroughfare excellently, so that one can read a newspaper from the path readily. The total candle-power of the sixty-eight gas lamps did not exceed one thousand. The twelve oil lamps give a combined candle-power from nine to twelve thousand, and the cost of maintaining these twelve lamps is less than the amount formerly charged by the gas company for the sixty-eight lamps.

I may also state that my British company

Fig. 10.

Portland Place, London, Lighted by the Kitson Petroleum Incandescent Lamps.

offered to light the whole of the sixty miles of streets of Marylebone for practically the same amount that is now being spent on the gas lamps, and guaranteed to supply the borough with ten times more light than that now furnished.

A good deal of criticism has been made by our opponents as to the attention these lamps require. I am free to admit that the oil lamp is more troublesome than a gas lamp, and that it requires more careful attention; but since there is no central station and no underground work in connection with the oil lamps, the total amount of labour is less than that required by a gas or electric light plant of equal illumination.

Our rivals should also remember that both gas lighting and electric lighting were in an exceedingly crude condition four or five years after they were first introduced, and that their development has taken a great number of years. The oil system is, of course, capable of improvement; it is not perfect, but it is being improved constantly. I believe, within a short time, all the difficulties enumerated will be overcome.

It is sometimes asked why most of the inventions in the industrial arts emanate from the United States, and just now there is considerable amount of agitation, and appeals are being made to British manufacturers to "wake up" and adopt the policy of the American manufacturers. I notice that one of the leading London papers ascribes the apparent lack of inventions developed in this country to the inert laziness of the British working man. In my judgment, one of the chief causes of the industrial and commercial prosperity of the United States is the enlightened system of Patent-laws which prevail in that country. The patent system of the United States was originated, and has been carried out mainly with a view to benefiting inventors, and giving them the fruit of their ingenuity. In the first place, the cost of obtaining and maintaining a patent is moderate. For the sum of £3, a man can make his application, and a further sum of £4 completes the payment necessary for a protection of seventeen years from the date that the patent is granted. Further, United States patents are granted only to the inventors themselves, or to their assignees, and in applying for a patent a man must swear that he believes himself to be the true and original inventor. In the next place a body of trained men are employed to make careful searches and prevent the granting of patents for trifling designs, or those lacking novelty. The keen competition amongst manufacturers compels them to adopt the most recent and up-to-date methods of manufacture; hence there is always a good demand for meritorious inventions. Contrast this with the English Patent-law system. A patent is granted here to any person who has knowledge of any invention, and there is no requirement that he shall be the inventor. In fact, a premium seems to be put upon theft, inasmuch as the applicant may have stolen the invention from the inventor, and if he succeeds in getting the patent, the true inventor is unable to get any redress.

Another hindrance to British inventors is the heavy taxation demanded for maintaining the patent, as it shuts out entirely the poor man who is working probably for a small salary

Since there is no examination in this country of the subject-matter of an invention, patents are granted to different applicants for the same idea, and the original inventor if he secures his patent is not safe until he has taken it into the courts and made good his claims. To do this involves the expenditure of so much money than the expense is often more than the value of the patent would be, even if he did succeed in establishing its validity.

Naturally a system like this affords no encouragement whatever to inventors, who, as a rule, come from the working-classes. This, in my judgment, is one of the secrets of the comparative dearth of inventions brought out in this country.

Englishmen, I believe, display as much native inventive genius as Americans when placed in the same congenial atmosphere. A perusal of the names of applicants for American patents will show that the majority are English or of English descent. It is satisfactory to know that a new Patent-law has been passed in this country which remedies some of the evils mentioned, but it is still much inferior to that existing in the States.

In conclusion, let me say that whilst I do not anticipate the extinction of electric and gas lighting by the introduction and development of incandescent oil lighting—in fact, I do not believe that it will seriously affect those industries except to stimulate gas and electric engineers to greater achievements in the economical production of light—I do claim that my system of lighting has obtained a permanent place in the field of artificial lighting and that in practice the old and wasteful

method of burning oil will become obsolete, giving place to the new system which I have had the honour of introducing and describing to you to-night.

DISCUSSION.

The CHAIRMAN said the paper was a very interesting and important one; and he believed all would agree that in these days of high-power illumination, when the whole tendency of the time was towards getting higher and higher units of illumination, this particular invention bade fair to play a most important part. In a street at the present time, new lanterns and burners were put on the old gas lamps, but still the amount of light did not seem strong enough, and there was a yearning for something yet stronger and more dazzling. The result was that the streets were torn up, at an enormous loss to the commercial residents of the neighbourhood to introduce the electric light. That electric light was said to give a 2,000 candle-power light per lamp, but one had grave doubts about the strength of the light when a lamp appeared to give merely 230 candle-power. Those who were connected with the gas industry wished they were allowed the same latitude with regard to strength of light supplied. In the case of the Kitson light the consumer not only had an honest light, which did what was claimed for it, but was one which could be installed without such great interruption of traffic, as was the case in electric lighting. For that reason alone, those who were smarting under the frequent upheaval of London streets, would welcome such a light as the Kitson with gratitude. Moreover, that light was exceeding good in quality. In using incandescent mantles the higher the temperature which excited the incandescence, the greater the candle-power of the light, and the whiter it was; thus it was possible to do colour-matching by the Kitson light. There still remained, among the poorer inhabitants in both town and country, a large amount of oil lighting. The statistics given by the author were not, he thought, at all exaggerated. The reason of its prevalence was, that the lamp among the poor was not only a source of light, but also of heat, which was a very great advantage. There was also the advantage that the fuel for the light could be obtained in cheap parcels. This principle was recently recognised in the case of gas by the introduction of the slot meter. But that need not disturb Mr. Kitson in the least in his calculations, because it was in the direction of getting large units of light that his system was of such enormous value. That method would not only be the cheapest, but it could be installed with the least possible disturbance. The various kinds of lighting naturally fell into their particular places and uses. He expected to see the Kitson light in four or five years a very big commercial success.

Mr. T. E. WEATHERALL asked whether Mr. Kitson could give an idea of the durability of the mantle for his lamp.

Mr. G. E. ROBINS asked whether any particular danger or difficulty was to be feared in the use of the Kitson lamp, especially with the mantles. How far would a portable lamp for domestic purposes stand being shifted about with comfort and safety? If such a lamp were fixed to a moveable bracket or chandelier how far would jarring interfere with its serviceableness? The presence of cold draughts had been admitted as a deleterious factor, and such draughts were inevitable in carrying lamps about from room to room.

Mr. A. C. BROWN asked whether Mr. Kitson had tried vaporising any other substances than those named; *i.e.*, on a lime cylinder as in the oxy-hydrogen light.

Mr. L. GASTER, speaking as an electrical engineer, said the author showed the cost of the light by his lamp as half that of gas under pressure, and one-fourth that of the electric arc light, and he would like to hear what standard the latter was assumed at, and on what basis the ·8 of a penny was obtained in the case of a Kitson. In the case of the electric light, the strength of the light depended on the form of current. In some districts in London the electric light was supplied at 2d. per 1,000 candle-power, as against the 3·5 pence given in the Table. Also at what price was the oil bought which formed the basis of the figures given? In England, practically all the oil used for the purpose of lighting was imported, and therefore dearer than in the countries where obtained. In electricity, the Nernst lamp threatened to hold the field, and that showed a reduction to one half in the cost. He thought Mr. Kitson was to be congratulated on the achievement of bringing out his lamp, and especially upon the great safety with which it could be used.

Professor C. LE NEVE FOSTER, F.R.S., asked whether the mantle, employed by Mr. Kitson, was the same as that used in the Welsbach lamp. He would like to hear how long it took to get a sufficient amount of heat to ensure vaporisation, and whether the process was easy, or difficult. He thought there was a great field for the lamp in connection with his own profession for lighting excavations underground. It might be used in some of the large underground slate quarries found in Wales, where it would probably save lives by enabling the men to detect where falls were likely to occur. The remarks made by the author about Philadelphia, were a repetition of what was said in New York by the head constable, when the

arc lamps were introduced, namely, that each arc lamp installed in the streets of that city, meant the reduction of the police force by one constable.

Lieut.-Colonel ALLAN CUNNINGHAM thought the most interesting scientific feature of the paper was the historical sketch showing how the sudden success of the electric light seemed to threaten gas, and then that was neutralised by the introduction of mantles, which enabled the gas to compete successfully with electricity. Then came the discovery of acetylene, which promised to become very useful. Then came mineral oil, which promised to be the best of the three in certain ways. They all filled their proper places, and would be successful side by side. He would like to hear how the lighting of the Kitson domestic lamps was done. One did not wish to have to apply a plumber's torch or other appliance in order to get the lamp to work. He assumed that Mr. Kitson's table of comparative cost was based upon very large units, for he only gave one thousand candle power units, which would be unsuited for ordinary dwelling rooms. In conclusion, he commented on the fact that some of the views shown on the screen were day-light views, and therefore gave no indication of the illumination of the streets by the lamps.

The CHAIRMAN, before calling upon Mr. Kitson to reply, remarked that he said the flash point of the oil used in the lamp was 100°, *i.e.*, a high flash point. Under those conditions, would not the Scotch oil be excellently adapted for the lamp? If so, one naturally felt a desire to see the home industry encouraged and developed, especially as the demand for liquid fuel was increasing.

Mr. KITSON, in replying on the discussion, said the question of mantles seemed to be the most important one raised. Considerable difficulty had been experienced in getting a mantle sufficiently strong to withstand the transportation of the lamp from place to place, and at the same time to get it to burn long enough to be economical. The mantle used was made especially for the Kitson lamp, and was not the same as was employed for gas, although the latter was often used for short periods. In a contractor's lamp, which was only required for a few hours at a time, the ordinary gas mantle served well. For street lighting a very much stronger mantle was needed. He would exhibit at the end of the meeting a mantle which had been in use one month, having burnt every night during that time from sunset to morning in a stationary lamp. The mantles had often burned for three months. For the household lamp, the mantles were found to burn between three and four weeks, when used every night. The mantles were more expensive than those for gas, costing about 9d. each. Some of the lamps were in very exposed positions, such as at the Liverpool and Mersey Docks, and if the mantles were not very strong, tl lamp would be useless. The average life of the mant there was about one month per burner. With rega to cold draughts affecting the lamp, that did n apply to the pressure lamps, which had been used a room with a fan blowing. A cold draught affect the ordinary domestic lamp, and caused it to smok With regard to the substances tried for the mantl the original material he tried was platinum. A lin cylinder had been tried, but the temperature of tl flame was not sufficient to warrant its use, and f high pressure lamps it would not be an economic light, nor successfully compete with the oxy-hydrog blow-pipe. He did not care to go into a comparis with electric light in the presence of the Chairma but while it was true that in some places the electr current could be got for 2d. per unit, the municipaliti which supplied it did so at a loss. One of the large consumers of the electric current for lighting in t country told him that the cost was 2¾d. per un even on a large scale. At the same place they we to-day using Kitson lamps because they consider them cheaper than the electric light. He thought tl figure given in the table, 3½d. per 1,000 candle pow for electric light would be generally considered a fa one at the present time in this country. The cost oil taken in compiling the table was 8d. per gallo which, as oil could now be bought at 6d., unde estimated the economy of the oil-lamp. As to tl time taken to start the lamps, the ordinary stre lamps were lighted in half a minute. Portlan place is lighted now in less time than when gas w used. In the case of some lamps the time taken light was not an important matter. For instance, the case of lighthouse lamps the time required start was immaterial, because a man was plac there for the sole purpose of looking after them. Tl contractors' lamps were lighted in one minute. O strong feature in favour of the Kitson lamp was t rapidity with which it could be installed. He relat an instance of this in the case of a railway accident a tunnel on the Baltimore and Ohio Railway, wh an electric company was asked to lay a light in t tunnel so that the dead bodies of the victims could brought out, and replied that it would take three hou His own company were then asked, and in half-an-ho from receiving the message the lamps were burnin in the tunnel. He admitted that the lighting of t domestic lamp was somewhat crude; but t economic results of the lamp fully paid for t trouble in starting. The heating of the mant was usually done by methylated spirit. Scot oil had been used in the lamp, but, being heavier, larger vapour tube was needed, and thus a long time was required for heating. The weight of t domestic lamp when full, was 10 lbs. Half the spa in the reservoir was occupied by air under pressure.

The CHAIRMAN proposed a hearty vote of than to the author, which was carried unanimously, an acknowledged.

Miscellaneous.

JURIES OF THE ST. LOUIS UNIVERSAL EXHIBITION.

The rules for the juries of the St. Louis Universal Exhibition, 1904, have just been settled, and have been officially announced. In general plan, these follow those drawn up by the French authorities in 1900, although, in several particulars, it has been found necessary to adapt the French rules to what may be defined as the "American idea," and also to the special character of the St. Louis Exhibition.

The total number of jurors in the international jury of awards will be 2 per cent. of the total number of exhibitors, each nation with fifty or more exhibitors being entitled to representation on the jury. Of this selected body of international jurors, three graded juries will be constituted, viz., group juries, department juries, and a superior jury. One hundred points will be the highest collective marking and will represent perfection, while the awards, four in number, will be allotted as follows: Exhibits receiving 60 to 74 marks inclusive - bronze medal; 75 to 84—silver medal; 85 to 94—gold medal; 95 to 100—grand prize.

Each grand jury will be composed of jurors and alternates, the latter in no case to exceed one-fourth of the number of jurors. The United States jurors and alternates will be nominated by the chiefs of departments to which the respective groups belong, while members representing foreign countries are to be nominated by the Commissioners of such countries. Women are to be represented in the juries, one juror and one alternate being appointed in cases where exhibits have been produced, in whole or in part, by female labour. Group juries are to be in the general charge of the chief of the department, and nominations must be made not less than thirty days before the opening of the Exhibition. The work is to begin thirty days after the opening, and is to be completed thirty days later. Special arrangements, however, will be made for temporary or short period exhibits. Each group jury shall choose its own officers, consisting of a chairman, a vice-chairman, and a secretary. It is, however, necessary that, of the two first-named officers, one shall be a citizen of the United States and the other must be drawn from a foreign country, represented at the Exhibition.

Department juries will be composed of the chairmen and vice-chairmen of the group juries of the various departments. This section also has the right to choose its own officers as in the case of the group juries. Their work will begin seventy days after the opening, and their duties will be to consider carefully and review the reports of the group juries, and to harmonise differences, acting both as arbitrators and peace-makers.

As to remuneration, United States jurors, except such as are officers and *employés* of the Exhibition, are to receive necessary and actual cost of transport, and compensation at the rate of 7 dols., or almost thirty shillings per day for such time as they are engaged in the work assigned to them at the Exhibition. Foreign jurors are to be paid by the countries they represent.

CAFFEINE IN COFFEE.

It has long been known that coffee berries usually contain something like one per cent. of caffeine, the substance to which coffee owes its stimulating properties. Recently M. Bertrand of the Pasteur Institute has analysed nine kinds of coffee with interesting results which are referred to in the *Agricultural News* Barbados. The beans of one species (*Coffea Humblotiana*) contained no caffeine, and in another species (*C. mauritiana*) only 0·07 per cent. was present. These two varieties are thus for all practical purposes free from the stimulating alkaloid. In Arabian coffee (*C. arabica*), obtained from various sources, the caffeine present varied from 0·83 to 1·60 per cent. Liberian coffee (*C liberica*) yielded between 1·06 and 1·45 per cent. The new African coffee (*C. stenophylla*) appears very rich in caffeine, 1·52 and 1·70 per cent. being the results of two analyses recorded. *Coffea Canephora* gave the highest caffeine content, 1·97 per cent. The paper is printed in *L'Agriculture pratique des pays chauds*, Year II., pp. 211-13.

Obituary.

REV. W. B. GALLOWAY, M.A.—Mr. Galloway, a member of the Society, who was elected as far back as 1869, died on Friday, 20th inst. He was born November 7th, 1811, and was educated in the High School, Glasgow, and at the University of that city, where he graduated. He commenced life as a portrait painter, but subsequently went to the University of Durham with the object of being ordained. He became Hebrew Prizeman and Licentiate in Theology. His first curacy was at Barnard Castle; he then removed to Brompton, and afterwards to St. Pancras. Canon Dale, Vicar of St. Pancras, appointed him to the new district church of St. Mark's, Regent's-park-road, which cure he held for some years. After 40 years of active life he retired.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'clock:—

APRIL 1.—"Application of Polyphase Motors to the Electrical Driving of Workshops and Factories." By ALFRED C. EBORALL, M.I.E.E. PROFESSOR JOHN PERRY, F.R.S., will preside.

APRIL 22.—"Modern Bee-Keeping." By WALTER FRANCIS REID, F.C.S. E. D. TILL, will preside.

APRIL 29.—"Automatic Wagon Couplings on British Railways." By F. A. BROCKELBANK.

MAY 6.—"The Construction of Maps and Charts." By C. J. MORRISON. Sir WILLIAM PREECE, K.C.B., F.R.S., Chairman of Council, will preside.

MAY 13.—"Preservation of the Species of Big Game in Africa." By E. NORTH BUXTON.

MAY 20.—"Fencing as an Art and an Historic Sport." By EGERTON CASTLE, M.A.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

APRIL 23.—"The Province of Sind." By HERBERT MILLS BIRDWOOD, C.S.I., M.A., LL.D. The EARL OF LYTTON will preside.

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D. The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M.P., will preside.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 or 5 o'clock :—

MARCH 31, at 4.30 p.m.—"British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo. The RIGHT HON. SIR GEORGE TAUBMAN GOLDIE, K.C.M.G., will preside.

MAY 5, at 4.30 p m.—"The Lagos Hinterland : its People and its Products." By MAJOR J. H. EWART.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock.

APRIL 28, 7.30 p.m.—Visit to the Whitefriars Glass Works. Paper by Mr. HARRY POWELL on "Modern Table Glass." (Special tickets required.)

MAY 19, 4.30 p.m.—"Mezzotints." By CYRIL DAVENPORT, F.S.A.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

W. WORBY BEAUMONT, Mem.Inst.C.E., "Mechanical Road Carriages." Four Lectures. April 27, May 4, 11, 18.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 30....Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

British Architects, 9, Conduit-street, W., 8 p.m. 1. Mr. H. Porter, "Fire Prevention." 2. Report on the Fire Offices Regulations.

Actuaries, Staples-inn Hall, Holborn, 5 p.m.

TUESDAY, MARCH 31...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Mr. Henry Walker, "British North Borneo."

Royal Institution, Albemarle-street, W., 5 p.m. Sir Robert Ball, "Great Problems in Astronomy." (Lecture III.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Percy John Cowan, "American Locomotive Practice."

WEDNESDAY, APRIL 1...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Alfred C. Eborall, "Application of Polyphase Motors to the Electrical Driving of Workshops and Factories."

Naval Architects (at the HOUSE OF THE SOCIET OF ARTS), 12 noon. Annual Meeting. 1. Addres by the Chairman, the Earl of Glasgow. 2. M W. H. Whiting, "The Effect of Modern Acces sories on the Size and Cost of Warships." Vice-Admiral C. C. P. FitzGerald, "The Lines Fast Cruisers."

Royal Archæological Institution, 20, Hanove square, W., 4 p.m. 1. Mr. C. E. Keyser, "Swa cliffe Church, Oxfordshire." 2. Mr. R. Garrawa Rice, "An Illuminated Pedigree of the De Ferre Family made in 1612."

British Archæological Association, 32, Sackville street, W., 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, APRIL 2...Naval Architects (at the HOUSE O THE SOCIETY OF ARTS), 12 noon. 1. Prof. W E. Dalby, "The Training of Engineers in th United States." 2. Prof. Angelo Scribanti, "Th Modification of the Mean Pitch due to Twistin the Blades in Screw Propellers." 3. Mr. H. M Rounthwaite, "Gradual Collapses of Furnac Crowns : a Suggested Explanation." 7 p.m. 1. M W. Cross, "The Ljungstrom Condenser as applie to Marine Purposes." 2. Mr. A. F. Yarrow "The Screw as a Means of Propulsion for Shallo Draft Vessels."

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mrs Gepp (Ethel S. Barton), "List of Marine Alg collected at the Maldive Laccadive Islands b Mr. J. Stanley." 2. Mr. D. T. Gwynn-Vaugha "The Comparative Anatomy of Cyatheaceæ an other Ferns."

Chemical, Burlington-house, W., 8 p.m. 1. Prof W. N. Hartley, "The Absorption Spectra of Nitri Acid." 2. Mr. M. O. Forster, "The Dioximes o Camphorquinone and other Derivatives of Isoni trosocamphor." 3. Mr. A. E. Dixon, "Salts of mercaptoid isomeric form of thioallophanic acid and a new synthesis of iminocarbaminethioalkyls." 4. Mr. E. G. Clayton, "Discoloured rain." 5 Mr. F. D. Chattaway, "Derivatives o o-aminobenzophenone and p-aminobenzophe none."

United Service Institution, Whitehall, S.W., 3 p.m

Royal Institution, Albemarle-street, W., 5 p.m Mr. C. N. Firth, "Society during the Common wealth and Pretectorate." (Lecture III.)

Civil and Mechanical Engineers, Caxton-hall, West minster, S.W., 8 p.m. Mr. Gilbert, "Desig and Testing of Centrifugal Fan."

FRIDAY, APRIL 3...Naval Architects (at the HOUSE OF TH SOCIETY OF ARTS), 12 noon. 1. Mr. J. P. Thearl "The Ballasting of Steamers for North Atlanti Voyages." 2. Mr. R. Balfour, "Marine Installa tions for the Carriage of Refrigerated Cargoes." 7 p.m. 1. Mr. W. A. Fairburn, "Fitting-Ou Wharf Crane in American Shipyards." 2. Mr. A W. Stewart, "Corrosion in Metal Pipes on boar Ship."

Royal Institution, Albemarle-street, W., 8 p.m Weekly Meeting. 9 p.m. Lord Rayleigh "Drops and Surface Tension."

Art Workers' Guild, Clifford's-inn Hall, Fleet street, E.C., 8 p.m. Paper on "Scene Painting."

Geologists' Association, University College, W.C. 8 p.m.

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square W.C., 8 p.m.

SATURDAY, APRIL 4...Royal Institution, Albemarle-street W., 3 p.m. Lord Rayleigh, "Light—its Origin and Nature." (Lecture VI.)

Journal of the Society of Arts,

No. 2,628. Vol. LI.

FRIDAY, APRIL 3, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

MUNICIPAL TRADING.

The following memorial has been addressed by the Council of the Society of Arts to the Prime Minister :—

Society for the Encouragement of Arts,
Manufactures, and Commerce,
John-street, Adelphi, London, W.C.
March 9, 1903.

To the Right Honourable ARTHUR JAMES BALFOUR, M.P., *Prime Minister and First Lord of the Treasury.*

SIR,

In the year 1899 the Society of Arts addressed a memorial to Sir Matthew White Ridley, as Secretary of State for the Home Department, asking for the appointment of a Royal Commission to consider the question of Municipal Trading. The Society then ventured to point out that there was an increasing tendency on the part of municipal and local authorities to embark in trading enterprises, which might be in competition with, or to the exclusion of, private enterprise ; and they drew attention to the fact that no limitations had been defined by Parliament as to the enterprises which should in the general interests of the nation be undertaken by municipalities and local authorities, and those which should be left to private effort.

During the time which has elapsed since the presentation of this memorial public attention has been much directed to the subject. The great and rapid increase in capital outlay by municipalities, and the consequential increasing burden upon the rates, has given rise to the feeling that certain definite principles might be laid down as to the class of undertaking upon which municipalities should enter. Further it has been contended that the action of municipal authorities has interfered detrimentally with private enterprise in many important industries.

The Society of Arts does not desire to prejudge the subject, but it feels that the question is one for an independent, impartial, and authoritative enquiry, such as could be conducted by a Royal Commission alone ; and they therefore venture to draw the attention of His Majesty's Government afresh to the matter, and to express to you their earnest hope that His Majesty's Government may see fit to advise His Majesty to appoint a Royal Commission, which, in addition to ascertaining and recording the facts, may lay down the principles and limitations under which Parliamentary powers should be granted to municipal and local authorities.

We have the honour to be, Sir,
Your obedient servants,

W. H. PREECE,
Chairman of the Council.

(L.S.)

H. T. WOOD,
Secretary to the Society.

APPLIED ART SECTION.

Messrs. James Powell and Sons have kindly invited the Applied Art Section to visit the Whitefriars Glass Works, Tudor-street, E.C., on Tuesday evening, April 28th, from 7.30 to 10.30 p.m. A short paper, "On Modern Table Glass," will be read by MR. HARRY POWELL, and the processes will be explained in the glass-house.

The accommodation is strictly limited and 100 tickets only will be issued. These tickets will be issued in order of application to Members until the number is exhausted. Each Member is entitled to apply for one ticket, which will be transferable.

No one can be admitted without a ticket.

COLONIAL SECTION.

Tuesday afternoon, March 31, 1903. The RIGHT HON. SIR GEORGE TAUBMAN GOLDIE, K.C.M.G., in the chair. The paper read was "British North Borneo." By HENRY WALKER, Commissioner of Lands, British North Borneo.

The paper and report of the discussion will be published in the number of the *Journal* for 17th inst.

Proceedings of the Society.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 1, 1903; PROFESSOR JOHN PERRY, D.Sc., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Bridgewater, Francis Matthew, 72, Coleman-street, E.C., and Terriers House, High Wycombe, Bucks.

Cromer, Earl of, G.C.B., G.C.M.G., K.C.S.I., C.I.E., British Agency, Cairo, Egypt.

Deeble, William Rufus, M.I.Mech.E., Chief Mechanical Engineer's Office, Tasmanian Government Railways, Launceston, Tasmania.

Fenix, George, Cala, Cape Colony, South Africa.

Fulton, Dr. Robert, M.B., Dunedin, New Zealand.

Lang, Sir R. Hamilton, K.C.M.G., The Grove, Dedham, Essex.

Langman, John Lawrence, 6, Stanhope-terrace, Hyde-park, W.

Lyons, Frank J., Penlee, West End-lane, N.W.

Mansfield, Richard, 316, Riverside Drive, New York, U.S.A.

Shadwell, Lancelot Horace Augustus, A.M.I. Mech.E., Engineers' Offices, Natal Harbour Department, Durban, Natal, South Africa.

Welsh, Charles, Winthrop, Highlands, Massachusetts, U.S.A.

Wingate, F. Melson, 103, Tavistock-road, Plymouth.

The following candidates were balloted for and duly elected members of the Society:—

Blenkinsop, Edward Robert Kaye, care of Messrs. H. S. King and Co., 45, Pall Mall, S.W., and Raipur, Central Provinces, India.

Draper, Rev. John Thomas, The Manse, East-street, Andover, Hants.

Hogg, John Thallon, A.M.I.Mech.E., Locomotive Superintendent's Office, Natal Government Railways, Durban, Natal, South Africa.

Thorp, John Thomas, 57, Regent-road, Leicester.

Vizetelly, Frank Horace, 200, West 142nd Street, New York, U.S.A.

The paper read was—

ON THE APPLICATION OF THREE-PHASE MOTORS TO THE ELECTRICAL DRIVING OF WORKSHOPS AND FACTORIES.

By A. C. EBORALL.

When it was first suggested that my paper to-night should deal with the use of electrical energy for the driving of workshops and factories, I quite recognised it would be a difficult matter to put forward anything new on the one hand, and to confine the paper within reasonable limits on the other. For the subject is a large one, covering a great deal of ground, on account of the many different classes of work met with, and, moreover, it is one that has been fairly exhaustively dealt with by many competent authors during the last five years. I decided, therefore, to limit the present paper in the manner indicated by its title, and hope that it may serve to provoke a discussion which will make up for its shortcomings by bringing out some new points.

The advantages of electrical driving are nowadays so generally known and appreciated, that it is not too much to say no other form of driving would be adopted for the case of any machine shop, foundry, steel works, etc., about to be established. But although many works, originally arranged for steam or other form of driving, have been converted, with the accompaniment of reduced cost and increased output, yet there is still a great deal to be done in this direction; again, the application of electrical energy in the textile industries has hardly made a beginning, at any rate, in this country. Hence there is plenty of important work for the electrical engineer in the near future in these directions, and now that the tramway and lighting undertakings in most of our large towns have been fairly established, there will be more time to study closely the special requirements of the above mentioned different classes of work, and this can only result in the universal adoption of electricity as the motive power. There is nothing standing in the way of such eventual conversion; on the one hand, the important and powerful electrical industry of the country must have suitable outlets for its products, and municipal and private power supply undertakings must obtain customers, while, on the other hand, the works engaged in the various industries cannot afford to neglect any means of reducing their costs of production, and increasing their outputs.

Of the two standard systems nowadays available for the electrical equipment of workshops and factories, namely, the three-phase and direct current systems, it is naturally largely a matter of opinion as to which will give the best all-round results in any given case. Each system has its advocates, who, I am inclined to think, often take rather a one-sided view of the matter; moreover, it is noteworthy that the most strenuous advocates of direct current-working for all classes of work are, as a rule, those whose actual experience in polyphase work is known to be practically nil, while, on the other hand, the strongest supporters of three-phase working are, I think, apt to lay a little too much stress on the commutator troubles which may arise with all classes of direct current machinery.

My own opinion in this matter is, that if each case is decided strictly upon its own merits, it will be found that a three-phase installation is preferable for most classes of work, because of its greater simplicity, flexibility, and reliability, it being, at the same time, cheaper to instal and to maintain. And the three-phase equipment appears to greater advantage in these respects, as the severity of the work increases, for a properly laid out three-phase plant possesses a capacity for standing overloading and rough treatment, which certainly cannot be equalled by the corresponding direct current equipment. It is only when a great deal of *economical* speed regulation is required that a three-phase system cannot hold its own with direct current working; as will be seen later, the question of economical speed regulation over a wide range is the weak point of the three-phase motor.

In giving the above opinion, I have by no means lost sight of the excellent work that can be, and is, done with modern direct current plant, when this is properly installed, and working under suitable conditions. The modern direct current generator or motor is a thoroughly well-built and highly efficient machine, which will operate, under proper conditions, perfectly sparklessly at all loads (with fixed brushes) up to overloads of 20 per cent. and even more. But sparkless commutation of the generators and motors is only maintained while the commutators remain in good condition, which means that they require continual attention—not very much, perhaps, but still a great deal compared with the attention necessary for the case of three-phase machinery. The commutator is the beginning and the end of nearly every trouble met with in direct current installations, and it must be admitted that, in unskilled hands, or in small sizes, it becomes an unmitigated nuisance, especially when the conditions under which it has to operate are unfavourable, such as dirt, vibration, etc.

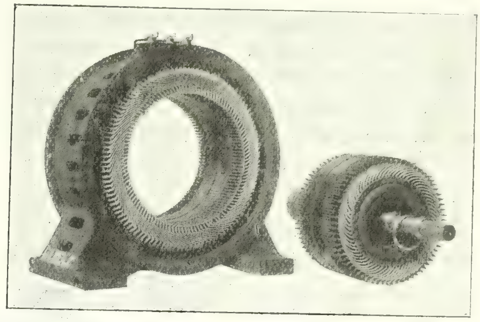
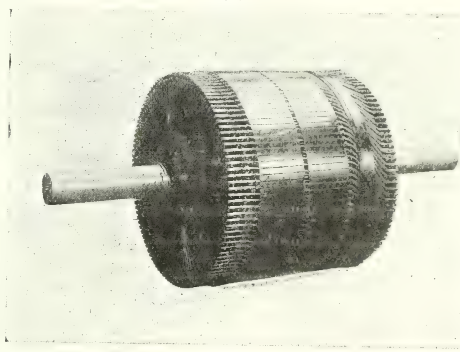


FIG. 1.—STATOR AND ROTOR OF A LOW PRESSURE THREE-PHASE MOTOR OF LARGE SIZE.

(*a*)



(*b*)

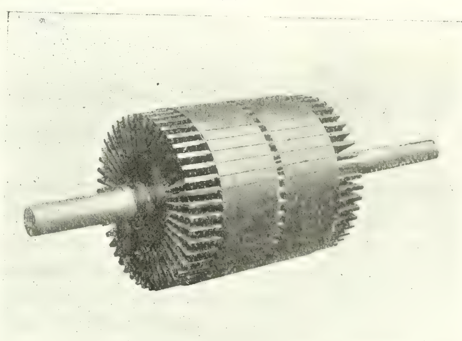


FIG. 2 (*a* and *b*).—TWO MODERN FORMS OF PERMANENTLY SHORT-CIRCUITED ROTOR FOR THREE-PHASE MOTORS.

It will now be advisable to consider as briefly as possible a few questions relative to the construction and performance of three-phase motors. As you are aware, such

motors are manufactured in two forms, namely (*a*), with permanently short circuited rotors, and (*b*) with wound rotors and slip rings. In each case the construction of the stationary stator is the same, and for all practical purposes the only difference between the two types, apart from the rotor construction, lies in the method of starting, and in the starting performance. The two constructions are illustrated in Figs. 1 and 2 (*a* and *b*) herewith, Fig. 1 representing a modern motor with wound rotor, while in Fig. 2 two modern forms

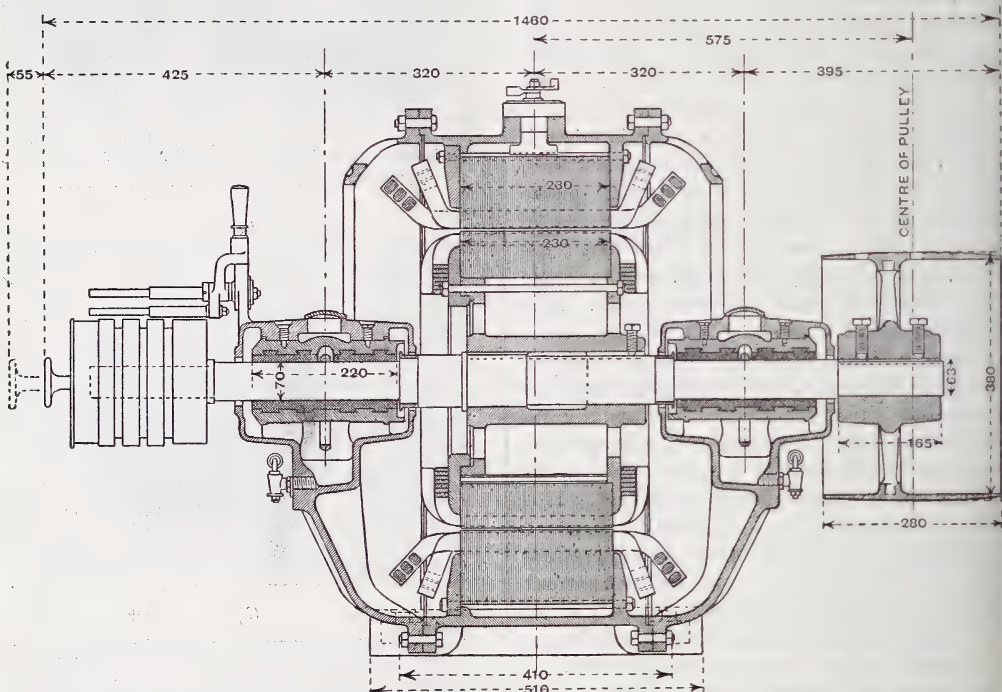


FIG. 3.—THREE-PHASE MOTOR WITH WOUND ROTOR AND SLIP RINGS. 45 B.H.P.; 220 VOLTS; 50 CYCLES; 950 REVOLUTIONS PER MINUTE.

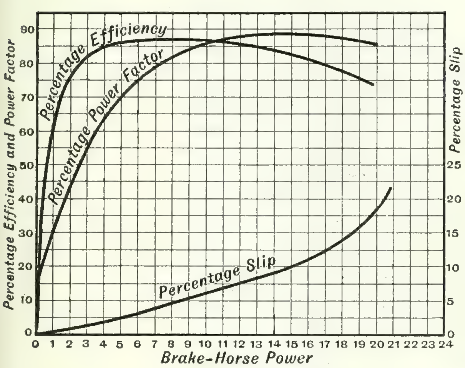
of permanently short circuited rotor are shown, either of which could be used with similar stators to that shown in Fig. 1. It may be noted in this connection that such permanently short-circuited rotors can be either arranged as indicated in Fig. 2*a*, the bars being short-circuited at the ends, by means of V-shaped connectors, or (for small motors) as shown in Fig. 2*b*, where all the bars are short-circuited at each end of the rotor, by means of radial connectors terminating in a common gun-metal hub. The object of short-circuiting the rotor bars through connectors possessing appreciable resistance, rather than by means of end rings (the so-called "squirrel cage" construction) is to improve the starting performance of the motor, the improved results in this respect more than compensating for the slight additional expense in construction.

Fig. 3 gives perhaps a better idea of the general construction of slip-ring motors than is given by Fig. 1; this motor, being of fair size, is provided with an arrangement for short-circuiting the slip-rings and raising the brushes, as soon as the starting resistance has been cut out, and the motor is at full speed. It pays to use such an arrangement with all larger motors, whenever possible, as not only is the wear on brushes and slip-rings thereby saved, but the losses in them, and in the cables between them and the rotor resistance, are done away with.

The three-phase motor with permanently short-circuited rotor is in all respects, except with regard to starting performance, an ideal type of motor to employ for all work requiring constant speed; for certain classes of work, in which the motor has to operate in a more or less inflammable atmosphere, it is the only type of electric motor that can be used with absolute safety for any purpose. Such motors in the smallest sizes are switched directly on

to the line, and, in the larger sizes, are either started on a loose pulley or equivalent arrangement in the same way, or, when this is not possible, they are started, with the help of an auxiliary transformer (the, so-called "compensator") at reduced pressure. However started, this type of motor takes a very large current at starting, at a very low power-factor compared with a motor of the slip-ring type, starting with equal torque; for this reason, such motors can in general only be used in

(*a*)



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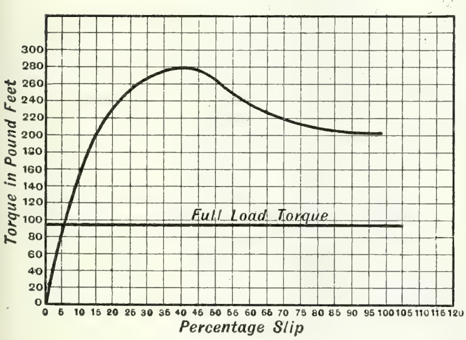


FIG. 4 (*a* and *b*).—CURVES SHOWING THE RUNNING AND STARTING PERFORMANCE OF A 10 B.H.P. 3-PHASE MOTOR WITH PERMANENTLY SHORT-CIRCUITED ROTOR, SPECIALLY DESIGNED FOR LARGE STARTING TORQUES AND INTERMITTENT WORKING.

small sizes if they have to be started with full load torque, on account of the effects which the large starting current produces on the pressure regulation of the supply system.

The actual performance of a motor of this type is shown by the curves given in Fig. 4 (*a* and *b*) which relate to a special 10 B.H.P. motor; these curves well illustrate the performance of such a motor *specially designed* for severe starting conditions, and hence working with a relatively high slip (6 per cent. at full load) on account of the high rotor resistance necessary in order to get good starting. It will be seen that, if thrown directly on the line, this motor will start, if necessary, with a torque equal to about 2·1 times the torque corresponding to full load; under these circumstances the current consumption would be equal to about five times the full load current. The maximum running torque is nearly three times the full load torque, and occurs at a little over half speed.

The performance of some smaller modern motors of this type, with regard to efficiency, power-factor, slip, and overload capacity, are given in tabular form below, together with their weights. These motors are of normal design and built for ordinary industrial purposes; in a machine shop such motors would find their use in the driving of portable tools and large independently driven tools. See, for instance, Figs. 5 and 6.

	Rating of motor in B.H.P.			
	1.	2.	3.	5.
Overload capacity before falling out of step in B.H.P.	1·6	3·6	6·6	10
Efficiency at—	Per Cent.	Per Cent.	Per Cent.	Per Cent.
50 per cent. overload	73	79	85	87
Full load..........	81	82·4	86·4	88·3
Half load	79	81	84	89
Power-factor at—				
50 per cent. overload	73	80	89	90
Full load..........	82	85	85	88
Half load	69	72	74	77
Slip at—				
50 per cent. overload	8	4·5	4·5	4·3
Full load..........	3·8	3·5	3·0	2·85
Half load	1·8	1·6	1·4	1·3
Weight of motor in pounds	143	194	265	352

NOTE.—All the above motors were built for 200 volts and 50 cycles, and run at 1,500 revolutions at no load. The temperature rise after a run of four hours at full load does not exceed 80° Fahr. for any motor.

The curves given in Fig. 7 are of considerable interest as illustrating the starting performance of a motor with permanently short-circuited rotor, when directly coupled to a centrifugal machine (Fig. 8). Such machines are largely used in sugar manufacture, in textile works for cleaning purposes, also for various other purposes, and represent a class of work which is certainly far better dealt with by a three-phase motor than by a direct current machine. With the latter proper commutation becomes an exceedingly difficult matter to attain, because of the unavoidable vibration and dirt, while on account of the situation of the motor below the drum, no great amount of attention can be paid to the commutator and brush gear. On the other hand, simplicity of manipulation is of great importance, as such machines are being continually started up and shut down, while again, considerations of proper mixing (in sugar refinery) demand a certain starting performance on the part of the motor, with regard to the acceleration of the loaded drum. The three-phase motor with permanently short-circuited rotor affords an ideal solution of the problem, provided that the requirements of the case are carefully taken into account in its design; such a motor lends itself readily to the stringent mechanical requirements, there is nothing to get out of order or to demand attention, while its manipulation simply calls for the operation of a three-pole switch.

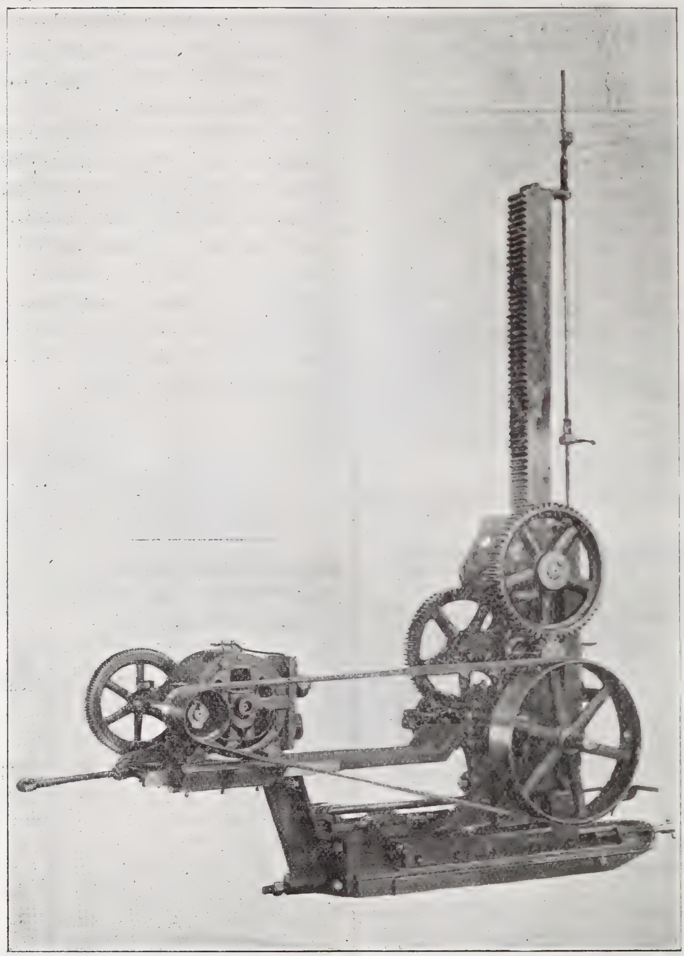


FIG. 5.—PORTABLE SLOTTING MACHINE WITH GEARED THREE-PHASE MOTOR OF ½ B.H.P. AT 1,425 REVOLUTIONS PER MINUTE.

The special starting performance is well

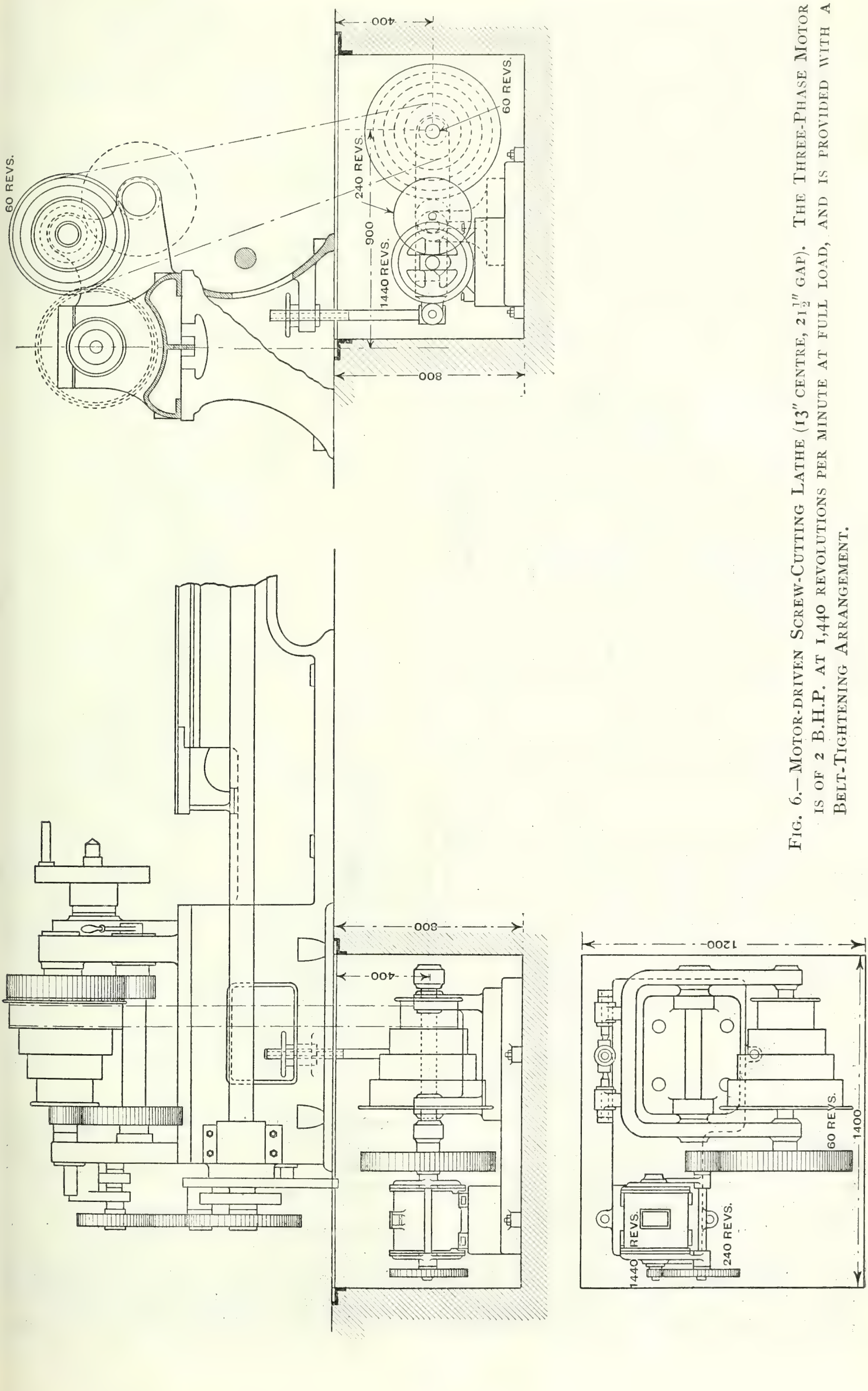


FIG. 6.—MOTOR-DRIVEN SCREW-CUTTING LATHE (13″ CENTRE, $21\frac{1}{2}$″ GAP). THE THREE-PHASE MOTOR IS OF 2 B.H.P. AT 1,440 REVOLUTIONS PER MINUTE AT FULL LOAD, AND IS PROVIDED WITH A BELT-TIGHTENING ARRANGEMENT.

shown by the curves of Fig. 7, relating to a motor of about 6 B.H.P. at 200 volts, 50 cycles and 950 revolutions. It will be noticed that on account of the considerable mass to be accelerated, this motor took about six minutes to reach full speed; at the moment of starting, the input of the motor is about 15 kilowatts, which drops to 5·8 kilowatts at full speed. The full load current of the motor is 18 amperes, and the initial starting current 80 amperes, or a little over four times as much; the power-factor is about 60 per cent. at the moment of switching on, gradually rising to 91 per cent. at full speed.

Two points may be noted before leaving this

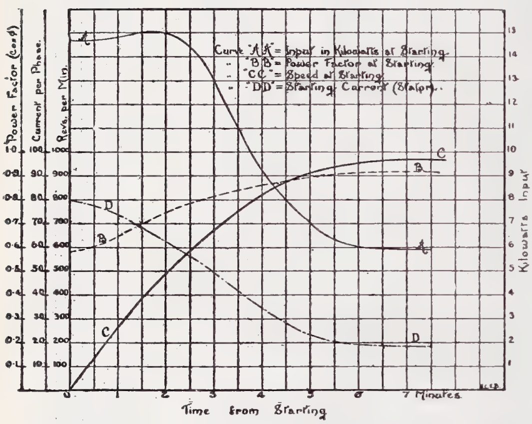


FIG. 7.—CURVES SHOWING THE STARTING PERFORMANCE OF THE SPECIAL THREE-PHASE MOTOR ILLUSTRATED IN FIG. 8.

particular matter. On account of the exceedingly severe starting conditions, such motors should be made as nearly fireproof as possible, with the help of asbestos-covered wire and micanite slot insulation for both stator and rotor; all connections must be made mechanically, without solder. Also, although generating plant of ample size is advisable, yet, if it is certain that the various centrifugals will never be started at the same time, advantage may be taken of the large fly-wheel effects of the machines running, which tend to maintain the speed of the engine constant, when the additional load comes on.

The motor-driven centrifugal above referred to furnishes an example of a particular class of work, in which the special properties of the motor with permanently short-circuited rotor, present such solid advantages, that there can be no doubt that the employment of another form—that is, of a slip-ring motor—would be a mistake. But, although plenty of such special cases arise in connection with shop and factory driving, yet, as already indicated, the use of such motors must not be carried too far for the case of ordinary installations, on account of the abnormal starting currents necessary if

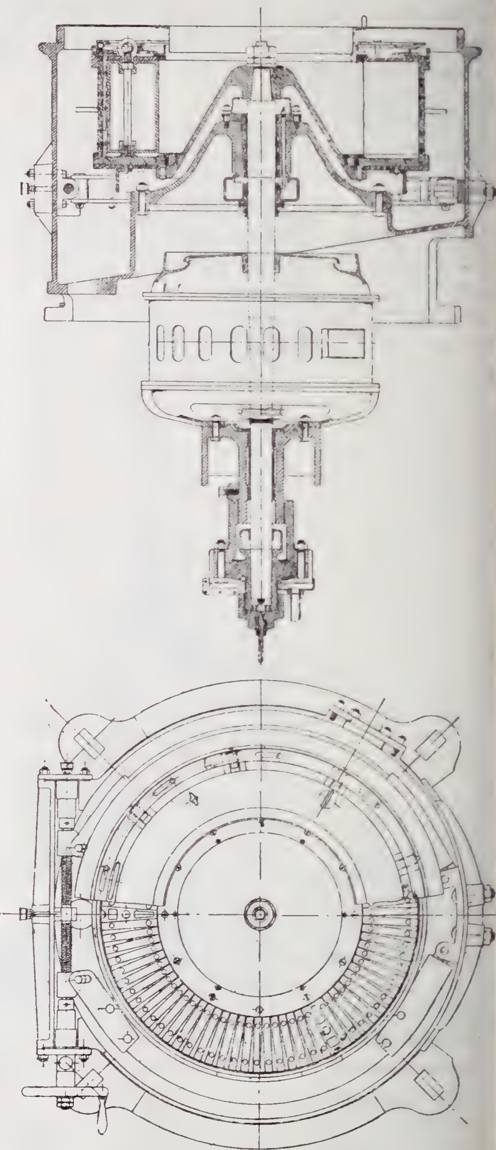


FIG. 8.—GENERAL ARRANGEMENT OF A CENTRIFUGAL MACHINE AND DIRECT-COUPLED THREE-PHASE MOTOR, WITH PERMANENTLY SHORT-CIRCUITED ROTOR.

they are required to start against load. A motor driving a line of countershafting, from which machine tools are driven, has usually to exert a torque at starting equal to about half that at full load, and if this motor has a perma-

nently short-circuited rotor, it will take about three times the full load current to get it up to speed under these conditions. Bearing in mind that the power-factor of this starting current will usually be of the order of 20 per cent., it will be seen that if the motor is a large one, the resulting drop of pressure over the system may be such as to impair seriously the quality of any lighting work on the same circuit, and may even affect other motors, because the output of these varies with the square of the pressure at the terminals.

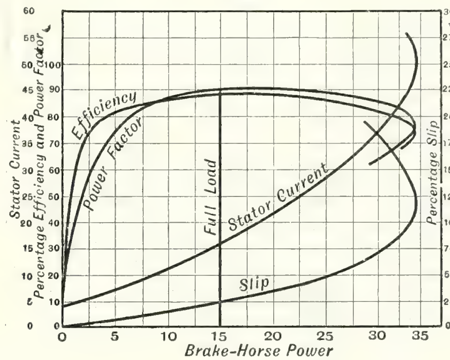
With the help of a properly arranged starting transformer, the above mentioned starting current could be reduced to less than twice the full load current, or again, about the same reduction could be obtained if the motor in question was started on a loose pulley, the power-factor in each case being, however, as low as before.

On the other hand, certain motors may have to start with a torque equal to, or greater than, the full load torque—the case of a crane is an example of this. Here, in order to get the necessary torque, the full stator pressure is required when starting, as a starting transformer cannot be used. For the case of a special motor of this class, we have already seen that, if required to start with the largest load it can deal with, the starting current is equal to five times the normal full load current, which would be an altogether abnormal amount if taken for more than a few seconds.

It follows therefore that, for any particular three-phase installation, there must be a limit to the size of motor which can be arranged for starting without a resistance. The limiting size will depend upon the size of the generating plant (relative to the size of motor), and upon the quality of its pressure regulation, as well as upon the frequency of starting and stopping, the amount of lighting on the same circuits, and upon the nature of the load against which the motors have to start. Above this limiting size, the ideal simplicity of the induction motor must be departed from to an insignificant extent, by employing a motor having a wound rotor and slip-rings, for use in conjunction with a starting resistance.* And I would say in this connection that, apart from special applications, I have not yet come across a case where part of the load consisted of lighting, in which it did not pay to start up all motors above about 5 B.H.P. either with the help of a rotor resistance or upon a loose pulley.

The use of a rotor resistance, when the motor has to start against load, presents the advantages that not only is the current consumption for a given torque greatly reduced,

(a)



(b)

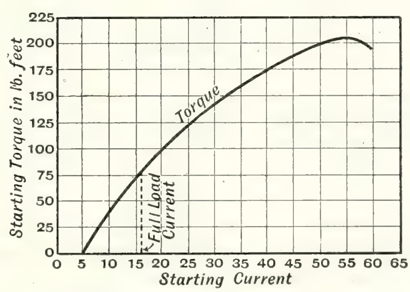
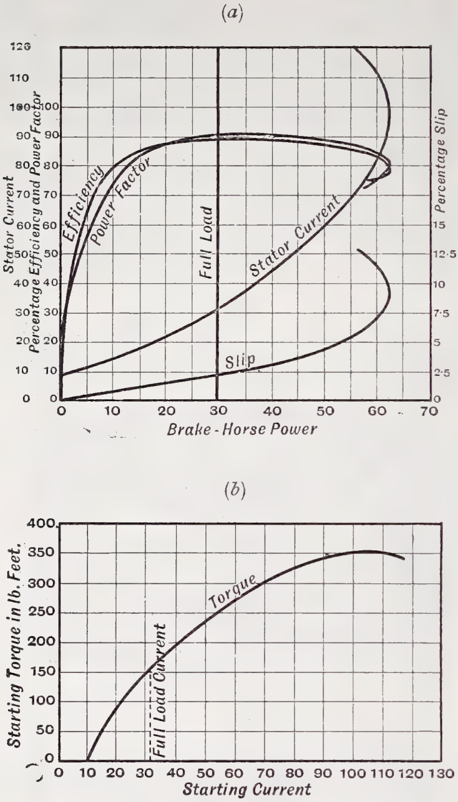


FIG. 9 (a and b).—CURVES SHOWING THE RUNNING AND STARTING PERFORMANCE OF A STANDARD THREE-PHASE MOTOR OF 15 B.H.P. OF THE SLIP-RING TYPE.

but the power factor of the starting current attains a high value approximating to the value it has when the motor is running well loaded. Moreover, the starting is gradual, in accordance with the requirements of the load, and it is perfectly under the control of the operator. The test curves given in Figs. 9 (a and b) and 10 (a and b) are typical of the running and starting performance of modern three-phase motors of standard design with wound rotors. As will be seen, such motors start with a torque equal to that at full load, with a starting current a little in excess of the full load running current; each of the motors

* It would appear that American practice fixes this limit considerably higher than Continental experience has shown to be desirable. The "squirrel cage" type of rotor was first developed on the Continent (by Dobrowolski and by Brown), but during recent years it has been entirely superseded by the slip-ring rotor for the case of large motors starting against load, except of course, for special cases. Certain manufacturing advantages, such as cheapness and uniformity of design, probably influence considerably American opinion in this respect.



FIGS. 10 (*a* and *b*).—CURVES SHOWING THE RUNNING AND STARTING PERFORMANCE OF A STANDARD THREE-PHASE MOTOR OF 30 B.H.P. OF THE SLIP-RING TYPE.

in question can, if desired, start with more than twice the full load torque. At this latter value of starting torque, the current consumption is of the order of two and a quarter to two and a half times the full load running current in each case. Such motors as these could be specially wound for much greater starting torques, but, under these circumstances, their running performance would not be quite so good; larger starting torques than these are very rarely required, except for crane, elevator, and similar work of an intermittent character, so that a slightly impaired running performance in such cases would not matter.

The starting performance of three-phase motors of the slip-ring type, compared with that of direct current motors, is well illustrated by the curves of Fig. 11, relating to certain commercial motors of standard design. Here the relation between starting current and starting torque is given for the case of (*a*) a series-wound direct current motor; (*b*) a shunt-wound direct current motor, and (*c*) a three-phase slip-ring motor; in each case the motor is rated at 13 B.H.P. at 500 volts, and runs at 950 revolutions per minute at this rating. As will be seen, the performance of the three-phase motor is practically as good as that of either of the direct current motors, up to a torque corresponding to that at full load, but, at the highest torques, the series motor is the most economical of the three, and the three-phase motor is the least economical under these conditions, there being, however, but a small difference between the performance of

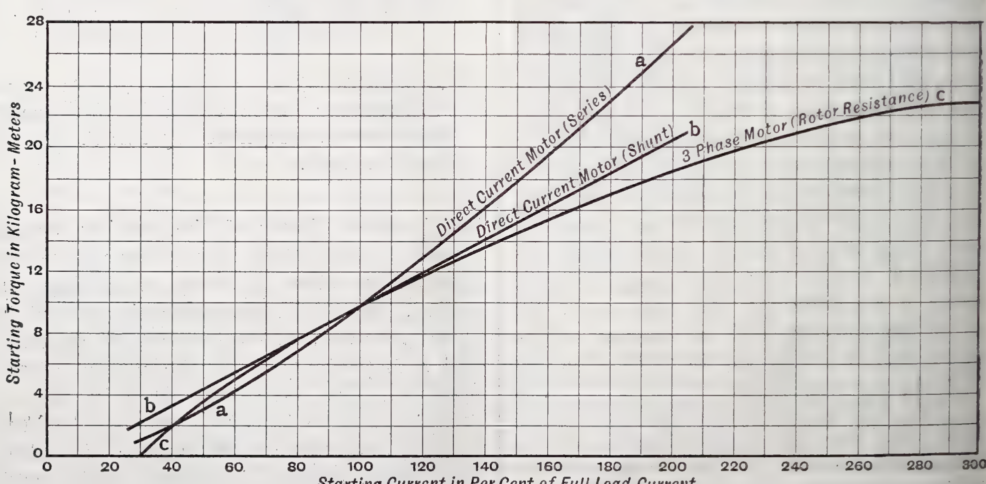


FIG 11.—RELATIVE STARTING PERFORMANCE OF DIRECT CURRENT AND THREE-PHASE MOTORS HAVING SIMILAR RATINGS.

the latter, and that of the shunt-wound motor.

The efficiencies at different loads of a standard series of slip-ring motors, operating under normal speed conditions, are given in the following table; the efficiencies of the smaller motors (having permanently short-circuited rotors) which complete the series, have already been given on page 467.

Rating in B.H.P.	Speed at full load.	Efficiency per cent.			
		Quarter-load.	Half-load.	Full load.	50 per cent. overload.
7	1,440	63	78	86	86
9	1,440	65	80	88	87
14	960	68	82·5	89	88
18	960	70	84	89	88
25	960	71	85	90	89
30	960	72	86	90	89
45	960	73·5	87·5	91	89·5
60	725	75	88·5	92	90
90	725	77	89	92	90

NOTE.—(1) All the above values are the average of the figures obtained on test from many different motors; all the motors were built for 200 volts and 50 cycles. (2) The temperature rise after a run of six hours at full load does not exceed 80° Fahr. for any motor.

A few words must now be said on the subject of the speed regulation of three-phase motors. For certain classes of work (for instance, crane and elevator work, and for yard locomotives, etc.) a certain amount of speed regulation of the motor itself is frequently required, and when this is the case, it follows that the slip-ring type of motor is the only one that can be employed. For we have already seen that the speed of the motor with short-circuited rotor varies within comparatively small limits between no load and the maximum torque it can exert without falling out of step—see the curves of Fig. 4. For a given load on the motor, the rotor slips behind the synchronous speed (that is, the no load speed) until the rotor current attains the value which is necessary for the torque, the torque (at constant stator pressure) being simply a function of the current in the rotor, which again is balanced by a corresponding current in the stator.

It is clear that, for a given value of rotor current (and torque), and at constant stator pressure (which means approximately a constant magnetic flux) the slip will be proportional to the resistance of the rotor windings, because under these conditions, the larger the rotor resistance, the larger must be the rotor E.M.F. necessary to produce the requisite current in the rotor windings. Hence, in order to vary the slip, that is, the speed, of a three-phase motor when working with a constant torque, it is necessary to vary the resistance of the rotor winding; this can only be done by employing a slip-ring motor, which allows of external rotor resistances being used for regulating purposes.

Thus the operation of a variable speed three-phase motor is analogous to that of a shunt-wound direct current motor, working with constant pressure on the field winding, and with a resistance in the armature circuit. In both cases the speed regulation means a corresponding reduction in the efficiency, because the input, for a given torque, is practically constant, it being independent of the speed. To illustrate this point, reference may be made to the curves of Fig. 12.

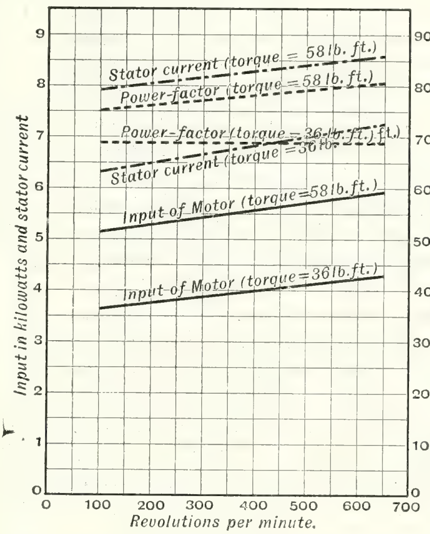


FIG. 12.—CURVES SHOWING THE PERFORMANCE OF A 5 B.H.P. THREE-PHASE SLIP-RING MOTOR WHEN OPERATING AT DIFFERENT SPEEDS AT CONSTANT TORQUE.

These curves represent the results of tests made on a standard motor of the slip-ring type, rated at 5 B.H.P. 500 volts, 25 cycles, and 720 revolutions as the normal speed at full load. Two tests were made (*a*) at a constant torque equal to the normal torque at full load (36 lb. feet), and (*b*) at a constant torque equal to 1·6 times the normal torque at full load (58 lb. feet). The constant torques at the different speeds were obtained by means of a Prony brake, the speed variation by means of rotor resistances, and the pressure on the stator

was maintained constant throughout the tests at 500 volts. It will be seen that, at constant torque, the values of the current and power-factor vary very little over the whole range of speed—that is, the input of the motor is nearly the same at all speeds. If the copper and iron losses remained the same, the curves would all be straight lines parallel to the base line, the output and efficiency of the motor (for a given torque) being directly proportional to the speed.

Of course the speed of a three-phase motor can be changed by altering the number of stator poles, but this method is not of general application on account of its limitations and disadvantages. At a given frequency the speed is inversely proportional to the number of pairs of poles on the stator, and hence a motor could be operated at two or more fixed speeds, by simply changing the connections of the stator poles by means of a suitable controller. This method, being independent of the rotor, can be employed with either type of motor, it being, in fact, more suitable for motors with permanently short circuited rotors, than for those with slip-ring rotors, for the reason given below.

Constructional reasons practically limit the number of pole-changes to two—for instance, a motor can be built to operate either as a four-pole or as an eight-pole machine, giving speeds (at 50 cycles) of 1,500 and 750 revolutions respectively. Intermediate speeds can only be obtained if the motors are of the slip-ring type, by means of rotor resistances as above described. Hence this method is more or less a makeshift, and it has, moreover, several electrical disadvantages; not only have motors arranged in this way to be larger, but their electrical constants are unsatisfactory at the lower speed—particularly the power factor. Again, if slip-ring rotors are used, because of intermediate speeds being required, or on account of starting conditions, it is clear that the polarity of the rotor must be changed simultaneously with that of the stator, which means that, in the above-mentioned example, for instance, the motor would require six slip rings instead of three. And, generally speaking, it does not pay to employ this method of varying the speed of a three-phase motor, except for quite special cases, in which a motor having a permanently short-circuited rotor can be used.

For all practical purposes, rheostatic (rotor) control is the only method of general application which is available at the present time for varying the speed of three-phase motors, and while it meets the requirements of all cases, being both simple and effective, yet it is clear that, from the economical point of view, the three-phase motor is at a disadvantage, compared with the direct current motor. The latter, when it comes to the question of economical working over a wide range of speed, is far more flexible. With the shunt motor, a certain amount of speed variation can be obtained by means of field regulation alone—naturally with great economy. For greater variations, this can be supplemented by means of rheostatic control, while, for very large amounts, it can be supplemented by means of series parallel control (employing a double wound armature) in addition to rheostatic control. Again, the series motor presents the great advantage of being inherently economical when used for the class of work demanding much speed variation, for the speed varies in accordance with the amount of the load; as we have already seen, the three-phase motor operates at practically constant speed, the speed varying only a few per cent. between no load and heavy overloads, that is, it does the heavy work at practically the same rate of speed as it does the light work.

But in connection with the driving of workshops* and factories, the question of economical speed regulation is of altogether minor importance; the requirements of most of the work necessitates, in fact, constancy of speed. In the textile industries, constancy of speed is of the first importance — practically all the machinery required for the different processes is arranged for this. Again, in machine shops, it is practically only the cranes that have to be considered in connection with regulation, for the necessary speed changes on the tools are, or can be, always arranged for quite independently of the speed of the motors, this being the standard method of working. On account of the proportion of the crane work to the whole, and because of its intermittent nature, it will not be found that the smaller economy of the variable speed three-phase motors on the

* Printing and similar establishments are not included under this head; at present only specially arranged direct current motors can be successfully employed in connection with direct driven printing machines. With this class of work, the requirements of the case necessitate a very great range of speed regulation, accompanied by the utmost economy of working, and, as indicated above, the three-phase motor does not at present lend itself to the latter requirement.

cranes, compared with that of direct current motors, will have an appreciable effect on the coal bill, the difference in any case being fully compensated for by the relatively smaller upkeep of the whole three-phase installation.

Of course, there is a certain class of work (for instance, steel work and foundries) in which the crane and similar work forms the bulk of the load, and, for such cases, it would be a question as to whether the better economy of working which would be obtained with a direct current plant would

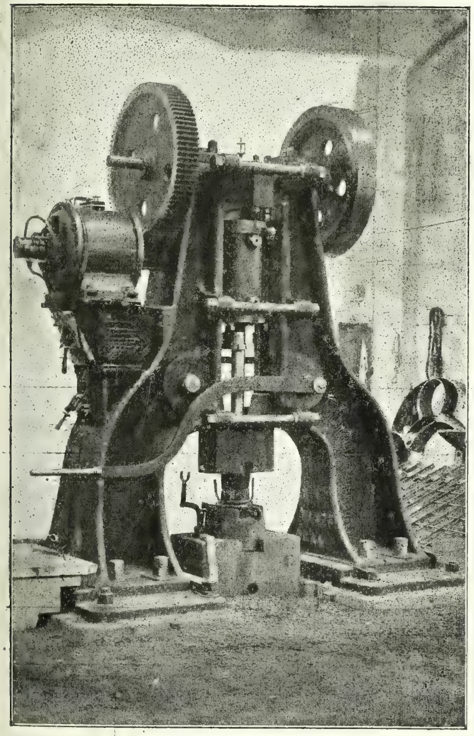


FIG. 13.—PNEUMATIC HAMMER DRIVEN BY A THREE-PHASE MOTOR OF 10 B.H.P. OF THE SLIP RING TYPE.

have a greater commercial value than the inherent mechanical advantages of three-phase motors for such work. For it must be remembered in this connection that the motors on a foundry crane, for instance, have to operate under conditions of quite exceptional severity. Frequently carelessly handled, and often overloaded, the motors work in an atmosphere of smoke, steam, and dirt, and although direct current motors are invariably totally enclosed when used for such work, yet even this does not fully protect them.

Returning to the subject of variable speed three-phase motors, in accordance with what has been said above, such motors will invariably be of the slip-ring type, the dimensions of the rotor resistance being such that this can be used for regulating purposes, as well as for starting. The usual form of such a resistance can be noticed from Fig. 13, which represents a motor-driven pneumatic hammer as used in a smith's shop. But it is preferable (for crane and similar work) to arrange the regulator in the form of a controller, just as in direct current work, as this is more suitable for use in unskilled hands. In this case, the stator switch is usually arranged in the controller case (on the small cylinder) and interlocked with the rotor resistance contacts (on the larger cylinder) just as for traction controllers; for the case of comparatively small controllers, the stator and rotor contacts are frequently on the same cylinder. The star connected resistance itself is, of course, external, being located away from the controller in any convenient position. In Fig. 14, is given the diagram o connections for a three-motor crane, each of the three-phase motors having its own controller and resistance; the controllers are represented in the form of developed diagrams, in the usual manner.

Having briefly discussed the fundamental matters connected with the performance and application of three-phase motors, I can now give a few notes relative to the use of such motors in connection with certain typical classes of work.

1. *Machine shop and similar work.*—Considering first the ordinary machine shop, the following tables will be useful, as showing the size of motor required for various classes of machine tools; these tables embody the latest and most accurate figures on the subject which are known to me, being based upon the tests and experiments of Mr. Lasche, of Berlin. In using them, it must be borne in mind that the ratings of the motors are based upon the performance of three-phase motors with regard to overloading capacity, that is, it is to be understood that the motors in question can carry overloads of at least 50 per cent. continuously. The figures and curves already given show that modern three-phase moters can do this with ease, with a trifling speed drop, and with high efficiency; by taking advantage of the great overload capacity of three-phase

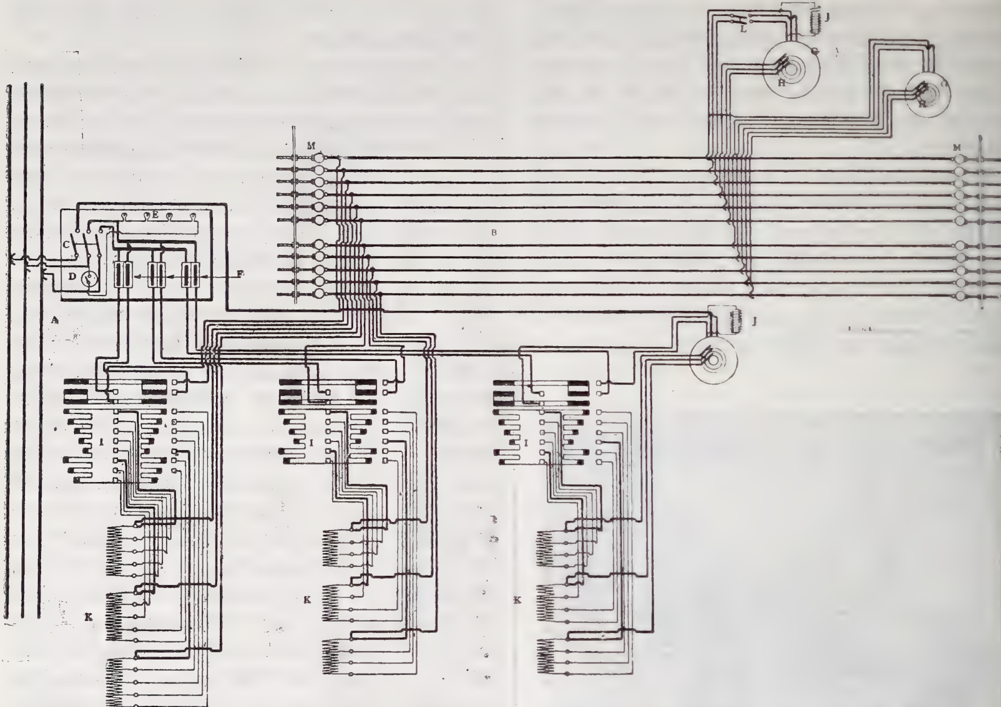


FIG. 14.—DEVELOPED DIAGRAM OF CONNECTIONS FOR A THREE-MOTOR THREE-PHASE CRANE.

motors, it is possible to avoid working them under-loaded. It pays in fact to put in motors a little too small for the work, as then they will always be working on the flat portion of the efficiency curve, and hence with maximum economy. The sizes of motor given in the tables for the different tools are based upon independently driven tools, the motors running at the standard speeds corresponding to frequencies of 40 or 50 cycles, and being geared down and then belted to the tools they have to drive.

For the case of the last table, dealing with pneumatic hammers, I am indebted to the makers of the tool in question for the ratings of the motors which should be employed to drive them.

A.—LATHES FOR SCREW CUTTING AND GENERAL WORK.

Height of centre.	Distance between centres.	Rating of motor.
Inches.	Inches.	B H.P.
$4\frac{1}{2}$ to 6	20 to 32	$\frac{1}{4}$
7 ,, $8\frac{1}{2}$	36 ,, 80	$\frac{1}{2}$
$8\frac{1}{2}$,, $12\frac{1}{2}$	40 ,, 100	1
14 ,, $16\frac{1}{2}$	100 ,, 140	$1\frac{1}{2}$
$16\frac{1}{2}$,, 19	140 ,, 175	2

B.—FACE LATHES.

Diameter of face plate.	Largest working diameter.	Rating of motor.
Inches.	Inches.	B.H.P.
36 to 50	48 to 64	2
60 ,, 63	64 ,, 93	3
80 ,, 100	106 ,, 140	5
158	212	10

C.—TURRET LATHES (WORKING WITH ONE TOOL).

Height of centre.	Largest working diameter.	Greatest working length.	Rating of motor.
Inches.	Inches.	Inches.	B.H.P.
9	20	33	1
$11\frac{1}{2}$	24	43	3
$11\frac{3}{4}$	$25\frac{1}{2}$	33	2
13	28	55	5
$16\frac{3}{4}$	34	63	5

D.—VERTICAL BORING MACHINES.

Diameter of table.	Greatest working diameter.	Rating of motor.
Inches.	Inches.	B.H.P.
50	51	2
68	84	3
82	96	5
83	120	5
158	300	15

E.—Horizontal Boring Machines.

Greatest height of bar.	Largest working length.	Rating of motor.
Inches.	Inches.	B.H.P.
21 to 25	40 to 80	$1\frac{1}{2}$
33 to 55	80 to 140	2

F.—Drilling Machines.

Pattern.	Maximum diameter of work on table.	Greatest distance from spindle end to table.	Rating of motor.
	Inches.	Inches.	B.H.P.
Quick speed	6 to 10	9 to 36	$\frac{1}{2}$
Pillar	10 to 13	32 to 48	1
Radial......	40 to 72	48 to 80	2
Three-spindle	6 to 6	31 to 35	1

G.—Milling Machines.

Pattern.	Dimensions of table.		Greatest distance from spindle to table.	Rating of motor.
	Length.	Breadth.		
	Inches.	Inches.	Inches.	B.H.P.
Universal (medium)	30	5	12	1
Ditto (heavy)	58	11	22	1
Vertical & Straight	70	14	22	3
Ditto	120	52	44	5

Wheel cutting machine for wheels of 20 to 48 inches diameter, 2 B.H.P.

Wheel cutting machine for wheels up to 55 inches diameter, 3 B.H.P.

H.—Grinding Machines.

Diameter of Emery Wheel.	Rating of Motor.
Up to 10 inches	$\frac{1}{2}$ B.H.P.
10 to 14 ,, ...	1 ,,
14 to 22 ,, ...	2 ,,

I.—Planing Machines.

To plane in length.	To plane in width.	To plane in height.	Rating of motor.
Inches.	Inches.	Inches.	B.H.P.
40	26	26	1
72	24	24	$1\frac{1}{2}$
84	26	24	3
120	38	38	5
120	49	49	$7\frac{1}{2}$
168	60	60	10
192	73	73	10
206	105	105	10

J.—Shaping Machines.

Length of stroke.	Traverse of head.	Greatest distance from underside of ram to table.	Rating of motor.
Inches.	Inches.	Inches.	B H.P.
$4\frac{3}{4}$	15	8	$\frac{1}{2}$
18	30	20	1
20	20	20	1
25	25	16	1

K.—Slotting Machines.

Length of stroke.	Width of slot.	Depth of slot.	Dimensions of table.	Rating of motor.
Inches.	Inches.	Inches.	Inches.	B.H P.
5	14	12	12 × 12	$\frac{1}{2}$
6	12	9	20 × 16	1
8	20	24	Diam. 28	$1\frac{1}{2}$
8	30	30	,, 30	$1\frac{1}{2}$

L.—Drop Hammers.

Weight of tup.	Largest drop.	No. of strokes per minute.	Rating of motor.
lbs.	inches.		B.H.P.
330	44	155	$7\frac{1}{2}$
550	50	126	$7\frac{1}{2}$

M.—Pnuematic Hammers.

Weight of tup with piston.	Length of stroke.	No. of strokes per minute.	Maximum height of work.	Rating of motor.
lbs.	inches.		inches.	B.H.P.
165	$11\frac{3}{4}$	220	$4\frac{3}{4}$	3
275	$14\frac{1}{2}$	200	7	$4\frac{1}{2}$
440	$17\frac{1}{4}$	180	$8\frac{3}{4}$	$6\frac{1}{2}$
660	19	170	$10\frac{1}{4}$	8
1,000	$21\frac{1}{2}$	150	$11\frac{3}{4}$	10
1,425	23	130	$13\frac{3}{4}$	12–15
1,870	27	110	$15\frac{3}{4}$	17–20

Note.—(1) The ratings of the motors given in the above tables are based upon the power required by the various tools *when operating at their quickest speed.* (2) The dimensions fixing the sizes of the different tools are somewhat irregular, because they have been converted from metric measurements to the nearest round numbers.

In connection with travelling crane work, the best practice with regard to the motors, is to use slip-ring motors in all cases for the lifting motion, and if the motor is above 4 B.H.P. in size, for the longitudinal motion of the crane also, in order to have perfect control of the

working of the crane. On the other hand, the motor for the cross traverse of the crab can invariably be arranged with a permanently short circuited rotor.

Generally speaking, for the case of *new* machine shops, it is by far better to arrange each tool with its own motor, as in this way the best all-round results will be obtained. The general convenience is greater, the total cost of the whole installation (bearing in mind the absence of overhead shafting, and the saving in the buildings) is inappreciably increased, and the all-round economy in working is greater in comparison with group driving.

II. *Textile Mills.*—The driving of textile mills furnishes an example of a class of work for which three-phase motors can be used with the best results; certainly they meet the various requirements of the case far better than direct current motors can do, whether the various machines are arranged for driving in groups, or for driving independently.

In cotton and woollen mills, the former arrangement is generally preferable; here no great reasons exist for separately driving the various machines, and there is a certain advantage in adhering to the usual arrangement of the mules, looms, etc., this standard arrangement being, in any case, well adapted to the application of electric motors for driving separate groups of machines. But in connection with the weaving of silk, perhaps one of the strongest arguments in favour of electric driving is, that each loom can be independently driven, thus doing away with all overhead shafting, and all risk of damage to the material to which the latter is otherwise constantly exposed. For it must be remembered that a spot of oil falling from an overhead shaft on to the loom, may spoil a whole piece of expensive material. Then again, should a thread break, it is a simple matter to stop the motor and loom immediately and automatically, both motor and loom being absolutely under control; the use of a three-phase motor in this connection is an ideal solution of the problem, as will be perhaps recognised hereafter.

FIG. 15.—COTTON LOOMS DRIVEN BY THREE-PHASE MOTORS.
(The motors are arranged in the manner indicated by Fig. 16.)

In spite of the highly economical engines usually used for the driving of textile mills, it must be admitted that the initial expenditure in the equipment and the cost of driving such mills might be materially reduced by the employment of electric driving. Any system of

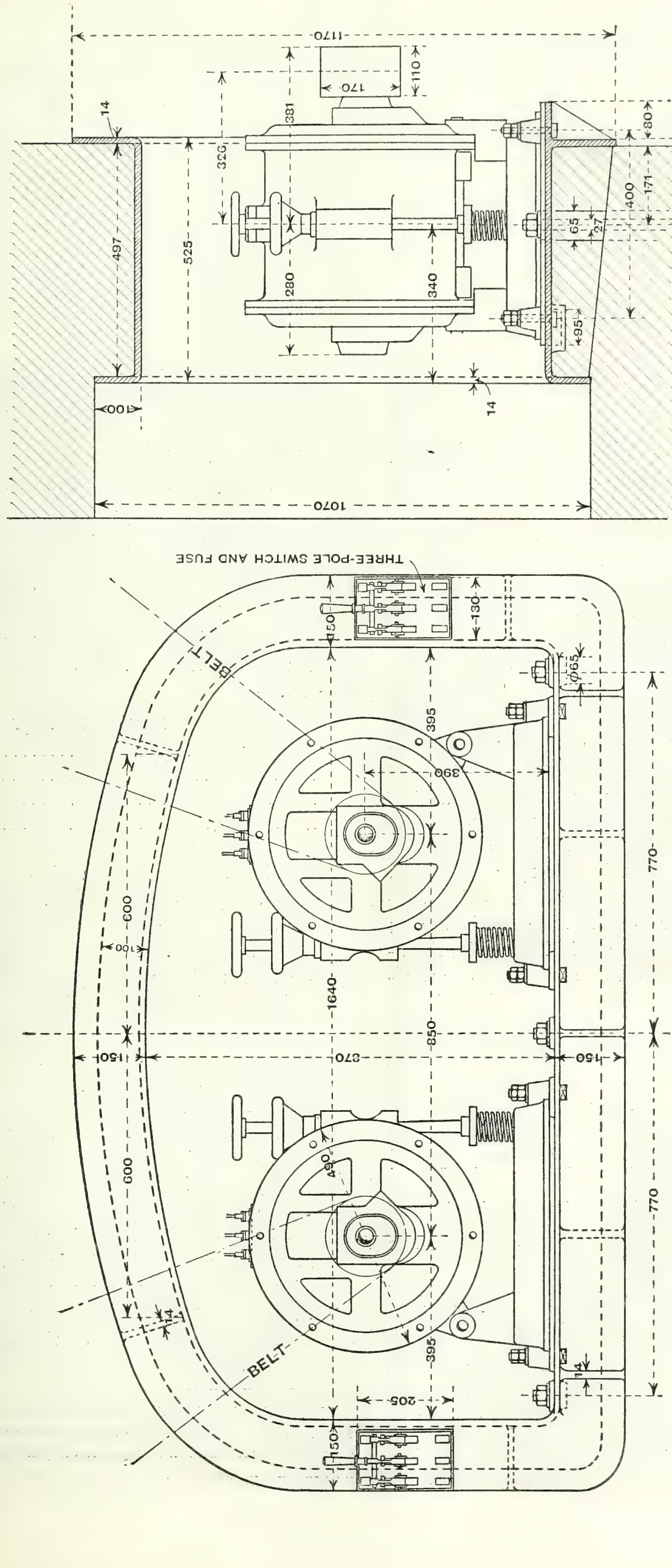


FIG. 16.—ARRANGEMENT OF TWO THREE-PHASE MOTORS OF 7 B.H.P. WITH BELT-TIGHTENING GEAR FOR DRIVING COTTON LOOMS FROM COUNTER-SHAFTING

electric driving would present the advantages of reduced costs of running and of increased convenience and smaller initial expenditure compared with the use of the usual belting and shafting. With a three-phase installation the full benefit is obtained, the initial cost of the driving equipment of the mill is reduced to the lowest possible amount, while the advantages of constant speed, total absence of sparking, extreme simplicity and reliability in working, negligible supervision, and the lowest possible maintenance charges, are inherent to the employment of three-phase motors for such work.

Fig. 15 shows the arrangement of motors adopted for the case of a certain cotton weaving mill converted from rope-driving to group-driving by means of three-phase motors. This mill was originally arranged in the usual way, the rope pulley of the driving engine working on to a countershaft, from which a series of ropes were taken through a spacious rope-way to the different rooms, the different transmissions being sectionised with the help of couplings. To say nothing of the loss of space and increased first cost of buildings, brought about by such an arrangement, the care of the ropes and the lubrication of the numerous pulleys is an expensive business, while the total loss of power in the various rope transmissions is, as a rule, 25 to 30 per cent. of the output of the main engine.

As usual the speed of the line shaft from which the looms are driven is 170 revolutions. From each line shaft 20 looms are driven, requiring altogether 6-7 B.H.P. on this shaft; each of the motors shown in Fig. 15 is, therefore rated at 7 B.H.P., at a speed of 860 revolutions, this specially low speed being chosen in order to obtain a direct belt drive. The motors are arranged in pairs, and are built into the wall, in order to economise space, as shown clearly in Fig. 16; they are virtually in a cast-iron case open at the front and closed by a removable cover (for inspectional purposes) at the back.

It will be noticed that each motor is pivotted at one side, and supported flexibly on the other by means of a spring, so that part of the weight of the motor is available for tightening the belt; the further tension necessary can be obtained by screwing down the motor against the spring by means of the hand wheel. The motors have permanently short-circuited rotors, and are relieved of most of the load when starting by means of screwing back the above-mentioned hand-wheel.

If the generator in the power station is directly connected to its driving engine, the efficiency of such an electrical transmission, that is, the ratio of the power given to the line shafting from which the looms are driven, to the brake horse-power of the engine, is 76-78 per cent., depending upon the size of the installation. But of greater importance that any direct saving that may be effected on the coal bill is the reduction in the working expenses, the saving in buildings, and the greater allround convenience brought about, which is particularly noticeable when extensions become necessary to the buildings.

The power required by the looms used in cotton weaving is comparatively small, but some of the machinery used in the cotton spinning industry requires a considerable amount of power. Fig 17 illustrates, for instance, the power developed by a three-phase moto[r] driving a line shaft (by belt) from which four self-acting mules were driven simultaneously and it also illustrates the characteristic fluctuations of power met with in this class of work.* The output of the motor, when working upon the individual mules alone, was a[s] follows:—

	Maximum H.P.	Average H.P.
Mule No. 1	20	13
,, ,, 2	18	9
,, ,, 3	15	9
,, ,, 4	15	9

Mules Nos. 1 and 2 had each 672 spindles running at 7,600 revolutions, while mule[s] Nos. 3 and 4 had each 684 spindles runnin[g] at 7,800 revolutions. The average power take[n] by the four mules working together is see[n] from Fig. 17 to be about 19 B.H.P., the maxi[-] mum being 32 B.H.P. The three-phase mot[or] driving them was rated at 35 B.H.P., and wa[s] provided with a fairly heavy flywheel, but, i[n] spite of this, the fluctuation in the power de[-] livered is considerable. The record given i[n] Fig. 17 was obtained by means of a recordin[g] ammeter placed in the motor circuit, from th[e] readings of which the corresponding horse[-] powers were deduced. It is worthy of not[e] that, under the conditions indicated, the spee[d] variation of the motor never exceeded 1·5 pe[r] cent. above or below the mean speed, which i[s] quite inappreciable even to the experience[d] eyes of the spinners.

* The author is indebted to Messrs. Brown. Boveri and Co[.], Baden, for these particulars. They relate to an installatio[n] carried out by this firm in a large cotton spinning and weavin[g] mill in Ghent.

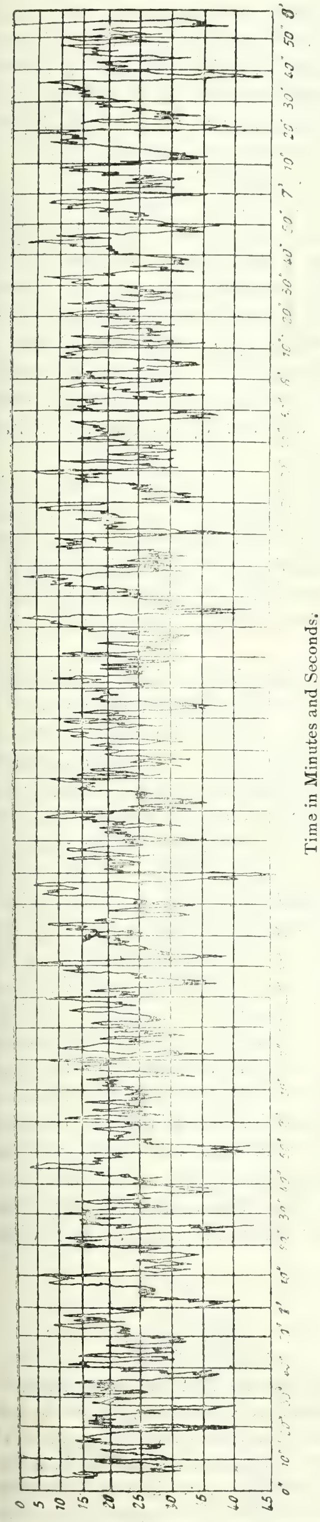


Fig. 17.—Record showing the Power taken by Four Self-Acting Cotton Mules working together.

Reference has already been made to the application of three-phase motors for driving silk looms, and to the necessity in this case of driving each loom by means of a small independent motor. The ordinary looms used in the silk weaving industry actually require about 0·25 H.P. to drive them, corresponding to 0·3 H.P. on the motor pulley; the larger Jacquard looms require more, necessitating motors of about 0·5 H.P. Such motors are, nowadays, invariably built for circuits of about 110 volts, and 37 cycles, so that when loaded, they run at 1,000 revolutions per minute; they are, of course, always of the three-phase squirrel cage type, as this is a class of work for which direct current motors are totally unsuitable, for obvious reasons.

Such a loom motor, of the latest type, is illustrated in Fig. 18, complete with its bed-

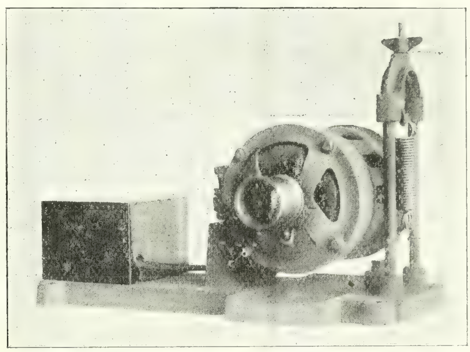


Fig. 18.—Three-Phase Motor of $\frac{1}{3}$ B.H.P. at 1,000 Revolutions per minute with Spring Suspension and Controller, for Driving a Silk Loom by Belt.

plate and (in the box on the left) three-pole switch and fuse. It may be noted as a special point that experience has shown a belt connection between the motor and the loom, to be far preferable to any other form—spur gearing for instance. This is because a belt connection, in conjunction with the flexible suspension shown, allows of easy and gradual starting of the loom, the motor starting nearly light on the slipping belt, and only picking up the load when its full speed is nearly reached. Further, should for instance, a thread break when the loom is at work, the loom is stopped at once by means of a brake acting upon the pulley of the loom, and although the supply of current to the motor is simultaneously cut off also, the motor would undoubtedly suffer if it was not flexibly connected to the loom. The use of a belt connection, in conjunction with a

motor pivotted on one side, and hung up on the other by a spring, as shown in Fig. 18, has given the very best results in practice, and I think it can only be a question of time before silk looms are universally electrically driven in this way.

The test curves of the loom motor illustrated in Fig. 18 are given in Fig. 19, and they well illustrate what excellent results can be obtained with three-phase motors by those experienced in their design. The weight of one of these little motors is only 50 lbs., of which the rotor weighs 10 lbs.; the weight of the complete arrangement as shown is 74 lbs. The

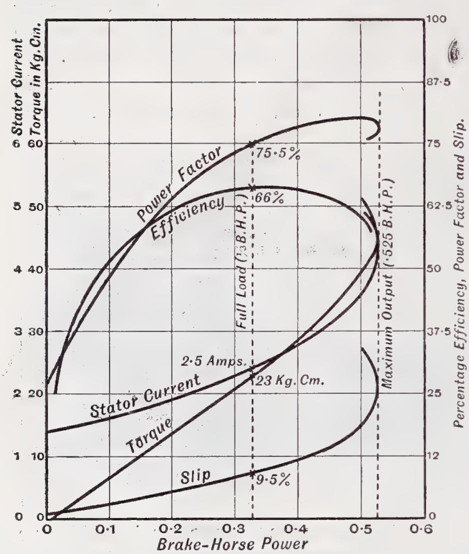


FIG. 19.—CURVES SHOWING THE RUNNING PERFORMANCE OF THE THREE-PHASE LOOM MOTOR OF $\frac{1}{3}$ B.H.P. ILLUSTRATED IN FIG. 18.

normal rating of the motor is $\frac{1}{3}$ B.H.P. at 37 cycles, 1,000 revolutions and 115 volts, but, as the curve shows, the overload capacity, before falling out of step, is 50 per cent. The full load efficiency is 66 per cent., the corresponding power factor 75 per cent., and the corresponding slip 9·5 per cent., all excellent figures, when the small size and weight of the motor are taken into account.

In conclusion, I would like to lay stress upon a few points bearing directly upon the satisfactory and economical working of a three-phase installation for power purposes as follows:—

1. The first requirement of the generators used for this class of work is that the pressure regulation should be satisfactory; such generators should have pressure drops not exceeding 16 to 18 per cent. from no load to full load (at constant speed and excitation), according to size, the power factor at full load being taken as 80 per cent. High engine speed is favourable to a good performance in this respect.

2. From all points of view it is highly desirable that the power factor of the motors should be as high as possible over a wide range of load; no motor above three horse-power in size should be put down whose full load power factor is less than 80 per cent. from half load up, and a flat power-factor curve over the working range of the motor should be insisted on.

3. The efficiency curve of the motors over the working range of load should be as flat as possible—many three-phase motors, even of large size, are not up to the mark in this respect.

4. A proper starting performance of the motor should be insisted upon, and, notwithstanding the ideal simplicity of the motor with permanently short-circuited rotor, the larger motors of this type should be installed with discretion, for the reasons given in this paper.

Regarding the above points, which amount to nothing more than that only really first-class material should be used if the best results are required, I am of the opinion that, in the real interests of all concerned, it would be better if users of three-phase machinery took a little more trouble than is usually the case, to make sure that they really get what they have asked for. Once an installation has been put down, it is not often an easy matter to ascertain whether each portion is working with the economy that was expected of it, and with regard to the motors, proper testing instruments are rarely found outside a maker's factory. But it is always easy to measure their current consumption on the brake after delivery, which is, at any rate, a criterion of their quality: it will invariably pay to do this, comparing the figures obtained with those worked out from the maker's guarantees for power factor and efficiency at the different loads.

DISCUSSION.

The CHAIRMAN said that the paper showed that the Standardisation Committee, which was doing such good work, must not be too quick in standardising electrical things, as we were still in a state of flux and of improvement. It was interesting to notice how slow we were in introducing motor-driven machines. In 1879 and 1880 they talked a great deal

about the immediate introduction of motor-driving, finding the enormous loss there was in the friction of shafting in cotton mills and spinning and weaving factories. Quite half the power in a spinning-mill was wasted in the shafting. It was obvious that the author was in favour of three-phase working, but he was exceedingly fair in putting forward not only the advantages but the disadvantages of it. The important new factor which had really come in was that there were large power-supply companies who wanted customers, and he thought that would introduce a good deal of driving by means of electro-motors. He thought the members would be struck with the smallness of the power required to drive slow-moving machine tools. The paper gave most important information as to the power required to drive many machines, and it would be welcomed by everybody who had to drive machines; even though they were not going to use three-phase motors at all, but ordinary direct-current motors. Another interesting point in the paper was where it was brought home to one that the fly-wheel effect of all the tools driven in that way, was added for steadying purposes to the fly-wheel effect of the driving engine. He was not sure that more could not be made out of a thing of that kind. There was one case in which the fly-wheel effect would be of enormous importance, and he supposed that everybody who had had to think about the driving of steamships, had thought about how to get a fly-wheel effect, how to prevent the racing of a screw. He would have liked the author to have mentioned that method of control for tramways and railways which was used by Ward-Leonard. He looked upon the three-phase system as of enormous importance for far transmission of power. One could get what voltage one pleased, and could transform in any way one pleased, and it seemed there were capabilities in alternating current work and three-phase work which could not be obtained in using the direct current. The author was trying to convince them that the merits of the three-phase system extended to transmission to comparatively small distances. There was an enormous advantage in there being no commutator. Anybody who had had to give advice with regard to the use of electric power in coal mines and other places where a spark was a dangerous thing, must feel the great advantage in certain cases in not having a commutator, not having a motor which would spark and give trouble. He hoped that some of the audience would deal with two important questions. Was there any difference in weight for a certain power? He supposed there was not much. Was there any difference in cost?

Mr. F. Broadbent said he had had occasion to advise on a question of power driving, and he had decided that in that case, a chemical works, the three-phase was the only proper system to adopt, on account of the rough nature of the work, the ignorance of the workers, and the simplicity of the system. In connection with it there would be perhaps some half-dozen centrifugal machines, similar to those described in the paper, but he was not at all satisfied as to what was the best type of three-phase motor to adopt—whether the short-circuit squirrel cage, or the wound rotor. As to the various applications of motors to driving machinery, he thought the continuous-current motor had a very decided pull over the three-phase in the question of speed control. Economy of power was not everything. In the ordinary machine tool shop there was a very great waste of power—50 per cent. was certainly not too high to put it, and in some cases 70 per cent. was reached when they were far off the boilers; but the total cost of the fuel, compared to the total cost of the product, was very small in the case of engineering works, because one was dealing with stuff that was very costly. Between 5 and 10 per cent. of the cost of the product would possibly be a fair figure for the total cost of fuel consumption in a machine tool shop so that, if by using electric motors one could entirely wipe out the fuel cost, possibly the cost of interest and depreciation of electrical plant would be greater than the saving effect. Three-phase motors would seem to have a very small advantage in that respect. But by the adoption of continuous-current motors one could so arrange the speed that one could double and treble the output of individual machines. There, he thought, the continuous current motor had a very decided advantage over the three-phase. As regards cotton mill driving, he thought any Lancashire engineer would be somewhat staggered to learn that he was losing 50 per cent. of his total power in a cotton mill. Twenty-five or 30 per cent. was as much as was usually lost. Anyone who had seen Lancashire factories in which the whole of the line shafts were driven direct, would consider a long time before dispensing with those ropes, which, perhaps, absorbed 5 per cent. of the power put through them, and putting down a three-phase or even a continuous-current motor, which would possibly lose at least 10 per cent. of the power sent through it. Constancy of speed was absolutely essential to cotton spinning. Was it not absolutely essential, in order to get that constancy of speed for that class of work, to use synchronous motors and not induction motors?

Mr. Leon Gaster said he had occasion, six or seven months ago, to visit the Roumanian oil fields belonging to the Stearra Roumana, and had an opportunity to see the installations erected for boring purposes. There the polyphase motor has been adopted in preference to the direct current one. The absence of sparking and the possibility of transmitting the power at a great distance have decided the people to take this system up. The electric power is generated from a water power, at about 20 miles away from the oil fields, and is trans-

mitted at 11,000 volts; the motor work at 500 volts. There are about 60 motors of 30 horse-power each in use, and the economy is about 40 per cent. compared to the old system of scattered boiler engines, which are a source of danger for fire on the fields, and ought to be replaced by effective motors, being much safer, and more economical in the long run.

Mr. W. L. MADGEN said that some of the problems which had been engaging the attention of Mr. Eborall had been of considerable importance for him. In the large power supply undertakings with which he was connected, they would undoubtedly use three-phase generators, three-phase transmission, and also three-phase distribution under certain conditions. In any case, they would use the first two, but the whole situation was affected at the distribution end by the fact that they had to supply tramways. Tramways required continuous current, so it appeared that they must have both types of current available for distribution. They required either motor generators or rotary converters for the purpose of locally transforming the current for tramway purposes, and while they were about it, it would rather seem that they should use the same class of apparatus and the same type of current for lighting and power purposes. But if some means were devised by which the traction could be run on the three-phase system it would greatly affect the whole aspect of the capital required for such an undertaking. If Mr. Eborall could throw further light upon that subject it would be of great use. There was a smaller undertaking with which he was connected—the Kidderminster Company—where they supplied continuous current direct to the tramways, and also to a number of factories in the town. They were informed by some of the factories that the output of their machines had been increased very appreciably; and by a firm of printers that the output of their machines had also increased. They were at a loss to understand what the reason was, and the conclusion they had come to was that previously the makers had not really known at what speed they were going. Now, however, the voltmeter gave a very simple indication of what they were doing. One remark made by Mr. Eborall rather varied with that which he had heard expressed by other engineers, and that was where he said that it was desirable that each machine tool should have a separate motor. It seemed to him that the small motor was very much dearer relatively than the large motor, and it was also less efficient. Therefore he thought it was not a point to dogmatise upon. In a considerable proportion of the cases it would pay to group the tools, with some reference to the cost and efficiency of the motors. He thanked the author for his excellent and lucid paper.

Mr. A. C. EBORALL, in reply, said that with regard to one of the Chairman's remarks, the reason for the motor in Fig. 8 taking that rather abnorm amount of power at starting was simply in order get a proper starting torque at a fairly reasonab consumption, the rotor resistance had to be ma much higher than would have been the case in normal motor, and a good deal of the power went wasting energy in the rotor itself by reason of th resistance of the conductors. With regard to the fly wheel effects of centrifugal machines, an ordinar induction motor when driven above synchronis started to generate current, and as the speed wa increased the motor would give an increase up to certain point, and after that it dropped. He had n practical acquaintance with the Ward-Leonard syster of motor control, but to anyone used to the three phase system it seemed complicated, although ther might be compensating merits. With regard to th comparison between direct-current and three-phas motors as to weight and cost, the weight of three phase motors, particularly in the larger sizes, wa below that of the corresponding direct-current motors figured on the same basis with regard to tempera ture rise, &c., and the cost of the whole three-phas plant was less, although the difference was no great. As to Mr. Broadbent's remarks on the ques tion of the best type of motor for centifrugal machines there was a certain advantage in using the motor with a permanent short-circuited rotor, on account of the simpler manipulation, but from the point of view of starting economy, there was no question which was the better motor to employ. One could not well use a starting transformer for motors of that kind, as Mr. Broadbent suggested. As to the speed control of machine tools, there was no difficulty whatever in regulating the speed of three-phase motors; it could be done quite as readily as with any direct-current motor. The whole thing turned on the economy obtainable at different speeds; the efficiency was proportional to the speed. He agreed with Mr. Broadbent that when economy of working at variable speed was of great importance then it would be a question whether the mechanical advantages of the polyphase motor would compensate for its disadvantage with regard to uneconomic speed regulation, but this is rarely the case. As to the loss of power in cotton mills, he had stated in the paper it was 20 to 30 per cent. It was, however, not so much the question of loss of power, because most of those mills were situated where coal was cheap, as a question of supervision, maintenance, general convenience, cost of buildings, &c. As to synchronous motors versus asynchronous motors, he did not think there was any advantage in the former. Even in the case of high-speed engines where one had the sets running in parallel, the requirements of parallel running necessitated that the drop of the governors should be of the order of 5 per cent., and hence a corresponding speed variation of the motors, and one would have a much worse state of affairs. Running a lot of little synchronous motors would

e a nuisance. The right way of tackling such work as to put in induction motors, preferably with hort-circuited rotors, and to arrange them so that hey could start without load by easing the belt, or in ome other way. They would vary in speed 3 per ent. from no load to full load. With reference to Ir. Madgen's question regarding three-phase traction e did not like to give a definite opinion, but or some years to come he thought that three-hase traction for ordinary street-tramways was bsolutely out of the question. On the other hand, or light railways and for long high-speed railways, to ut in any other than the three-phase motor would e, generally speaking, a mistake. With tramway ork one had a whole lot of troubles with iree-phase current — two overhead conductors, ouble with the rails, noise in the telephones, id very uneconomical speed control. The alter-ative to the series parallel control, the cascade ontrol, was much too complicated at any rate r 30 horse-power motors. Even if they could et an induction motor with a power factor of nity he did not think it would help matters uch, but with the long distance lines it was another atter altogether. One disadvantage was wiped off the fact that one did not get incessant starting id stopping. When it came to long lines, as for stance from London to Brighton, it would be a id plan to put sub-stations all the way down. he right way was to put three-phase motors on the rs, working them directly at high pressure from the gh pressure trolley lines, at say, 3,000 volts by eans of three-phase transformers. Those 3,000 volt rrents could be collected with ease and safety. he advantages were the doing away with the rotary nverter sub-stations, the avoidance of collecting ry heavy currents on the trolley, and the constant eed of the motor. But the power-station equip-ent would have to be somewhat larger than the rresponding equipment—probably 20 per cent. ger—to make up for the wattless currents. As to ether each tool should have its separate motor, whether the tools should be grouped together, at was very largely a matter of opinion. One uld only put a separate motor to each tool in the se of new works; and in comparison with the cost the machine tools the cost of the motors was all. The efficiency in working is not very ferent.

The CHAIRMAN thought it had been brought home everyone, that the academic notion of efficiency s a very poor notion indeed; he would go further, d say that mere efficiency with regard to money d things which were bought with money, was not ough: there was a higher efficiency than that. yone who had been in the most modern machine ops, and seen the separate tools driven by separate tors, must feel that it was not efficiency that came not the cost of motors; it was that the whole shop was a model thing, more efficient, better disciplined, and altogether different from what it used to be. It made all the difference between profit and loss all round. Mr. Eborall had answered Mr. Madgen by saying that he did not think we could have efficient three-phase working on tramways. He advised Mr. Madgen not to be satisfied with that answer. He was certain that Mr. Eborall had never had it put squarely before him. As Mr. Eborall was probably the man who knew most about the subject in this country, if it were put squarely before him he would find there was a solution. He moved a vote of thanks to Mr. Eborall for his interesting paper.

The vote was carried, and the proceedings terminated.

Miscellaneous.

HONITON LACE-MAKING IN EAST DEVON.

The revival of lace-making, as a local industry, in the several counties that have been formerly famed for its manufacture, has received attention at the hands of the Devon County Council, who have recently drawn up an important report on the present conditions of the industry, and the best means of developing and organising it in East Devon. The salient points of this report have been recently summarised in the *Devon and Exeter Gazette*, from which the following notes are taken:—The art of making lace by hand has existed in East Devon since the commencement of the 17th century, and although it may have been common before that period, it was about that time that it received considerable impulse by the arrival in England of Flemish lace-makers; and the strong resemblance of the old Devonshire laces to those formerly made in Flanders, bears out the theory of its Flemish origin.

Thomas Fuller, writing about 1662, says:—"Much bone lace is made in and about Honyton, and weekly returned to London. Hereby many children who otherwise would be burdensome to the parish, prove beneficial to their parents. Yea, many lame in their limbs and impotent in their arms, if able in their fingers, gain a livelihood thereby, not to say that it saveth some thousands of pounds yearly, formerly sent over seas to fetch lace from Flanders."

In the 18th century, under the influence of fashion, the artistic excellence of Devonshire lace began to deteriorate, until at the commencement of the 19th century the invention of Heathcote dealt a fatal blow at the Honiton lace makers. A hopeless struggle ensued between manual labour and the results of science, and in the end the hand-made material was

forced to give way to the cheaper but inferior productions of the machine. The mode, too, in which the manufacture of hand-made lace was carried on was not likely to ensure its success. Children and young women congregated together in badly ventilated rooms in country cottages, worked at their pillows under conditions where were usually insanitary. By the slovenliness of the work and the want of improved patterns the industry was brought down to the lowest condition,

The Education Acts of 1870 and 1876, which rendered it impossible for parents to keep their children at home and employed in the manufacture of cheap sprigs of lace, were really a blessing in disguise, for though they dealt a further blow at the lace industry, yet they were largely instrumental in improving the condition and character of those girls who would otherwise have been brought up to the lace trade.

Children who had been kept much at home had now, by the necessary walk to and from school, and the better ventilated condition of school-rooms, the chance of a more healthy existence, and the elder girls, who, by their enforced attendance at school, had lost that early instruction in lace-making which fitted them to work with care and quickness, turned their hands to other employments. The attendance at school left little time of daylight for lace-making, and the crowding together of young girls in cottage homes had to be given up. During the last fifty years, various attempts have been made to encourage the lace industry by the provision of improved patterns, more careful attention to the old, and the introduction of new, stitches.

The late Queen Victoria—the lace for whose wedding dress was made at Beer, in East Devon—ordered bridal dresses and veils to be made of Honiton lace for her daughters. Various private persons have, from time to time, taken pains to procure for lace makers new patterns of flowers, insects, and other natural objects, and when many of these were put into execution the workers were delighted at their success, though they had previously declared it to be impossible to produce them.

In the hope of reviving the industry, the Bath and West of England Agricultural Society offered prizes for lace exhibited at their annual shows. The invitation was accepted by many of the lace makers and dealers, and these exhibitions did much good in bringing the industry to the notice of the public, and in promoting not only the sale of lace, but also much improvement in its manufacture. In spite, however, of this help, the lace industry continued to languish, and it is only within the last few years, when the productions of the Devonshire workers have been exhibited at the Chicago, Paris, and other exhibitions, that an increased demand for Honiton lace has arisen. During the year 1901 especially, whether owing to a change of fashion, or to the prospects of the Coronation, the Devonshire workers had more orders than they could fulfil.

The revival of the last few years has affected princ pally two districts—that of which Honiton is t centre, and that lying round Seaton, Beer, and Bran combe. In the Honiton district, lace classes have be aided for some years by the district committee f Technical Education, at Honiton, Ottery St. Mar and Sidbury. At Beer, classes have been aided l the Axminster District Council, and the lace made the district has been practically sold by the individu workers helped by exhibitions arranged by those wl have taken an interest in the matter. A considerab amount of the lace made is bad in design and little value, and the thread used is of inferior qualit From the few returns received it is certain that, least, 700 persons are engaged in lace-making East Devon.

The hope is expressed by the sub-committ charged with the consideration of this question, th the revival in the lace industry will not prove of mere transitory nature, especially if steps are take to give further instruction, not only in the art of lac making, but also in the production of improve patterns. They are of opinion that the Coun Council should lend its aid in fostering and improvir an industry which, in the past, has done so much afford occupation for a large portion of the workin classes.

This industry is, so to speak, endemic in th country; it is especially a cottage industry which ma afford additional earnings to the families of th country labourers; it requires no elaborate or e pensive plant, for a pillow and a set of sticks, a fe pins and a supply of good thread is nearly all that necessary for the production of a very beautiful an costly material; and it affords a means of livelihoo to many, who would, otherwise, be dependent upo parochial relief.

The County Council may appoint a staff teache to give and organise instruction in lace-making an to the carrying out of other recommendations, whic should lead to successful results, and for this purpo advertisements have been inserted in the local pape inviting applications for the post of "Instructress i making Honiton Lace," at a salary of £80 per annum with travelling expenses.

COTTON-GROWING IN THE WEST INDIES.

Dr. D. Morris, Commissioner of Agriculture for th West Indies, has collected particulars respectin cotton cultivation in the West Indies, which has bee published by the Imperial Department of Agricultur for the West Indies. Dr. Morris writes:—

The keen interest that is being taken at the presen time in the possible revival of cotton-growing in th West Indies, has suggested the issue of a summary o information that may be usefully consulted by thos desirous of embarking in the industry.

The experiments in cotton-growing, started in 1900, at St. Lucia by the Imperial Department of Agriculture, were instituted with the view of bringing into cultivation lands that had once been in sugar, but had been abandoned, owing either to the poverty of the soil, or the arid nature of the climate. It was hoped, as in Carriacou, that some varieties of cotton would withstand conditions unfavourable for the sugar-cane, and bring in returns that would still leave a margin of profit to the planter.

Later, owing to the rapid fall in the price of sugar, the idea of taking up the cultivation of cotton as subsidiary, or in lieu of that of sugar, was seriously entertained by the planters at Montserrat, Antigua, and St. Kitts. There are at present about 600 acres under experimental cultivation in cotton in these islands.

There is no doubt that the West Indian Colonies are well adapted for the cultivation of cotton. They formerly grew comparatively large quantities, and in fact a hundred years ago supplied nearly the whole of the cotton from the New World shipped to Europe. In 1801, 25,000 bales were exported; in 1836, 20,000 bales. Afterwards cotton was discarded in favour of sugar, and other crops, yielding larger profits. There was a slight revival of cotton planting in the West Indies during the civil war in America in 1863–1865, but since that time cotton has almost disappeared from our lists of exports, the only locality where the cultivation has survived being the small island of Carriacou—a dependency of Grenada.

Where it is clearly evident that sugar cannot be produced at a profit the cultivation of cotton would offer employment to a large section of the community, and if careful attention were devoted to growing the varieties of cotton best suited to the soil and climate and these, happen, as in the case of "Sea Island" cotton, to command relatively high prices, the industry would have a reasonable chance of success.

In 1900, the consumption of cotton in Great Britain was 3,269,000 bales, while in the United States it was 3,727,000 bales (bales weighing 500 lb. each). If, as is probable, this supremacy is maintained, the United States will have less cotton to export in the future, and Great Britain will be more dependent on other sources. The following figures taken from the *Board of Trade Journal* indicate the countries whence Great Britain receives at present its chief supplies of raw cotton:—

	1902. Bales.	1901. Bales.
American	2,958,917	3,150,797
Brazilian	236,768	51,557
East Indian	68,890	80,912
Egyptian	487,474	389,371
Miscellaneous	59,106	70,207
Total	3 811,155	3,742,844

It will be observed that while the total imports into Great Britain in 1902 were about 70,000 bales in excess of those of 1901, the supply from the United States in 1902 was about 192,000 bales less than in 1901. This deficiency was more than made up by the increased shipments of Brazilian cotton. These rose from 51,557 bales in 1901 to 236,768 bales in 1902.

The chief sources of the supply of raw cotton other than the United States are Brazil, East Indies and Egypt. The same factor is probably operating in Brazil as in the United States, viz., that a larger proportion of raw cotton is being retained in the country to be manufactured locally. Similar circumstances are also believed to be operating in India, and her own mills are taking a large and increasing proportion of her crops. At all events, there has been a considerable falling off of late in the imports of Indian cotton into Great Britain.

The supply of cotton from Egypt, however, has been steadily increasing. The total exports from that country in 1900 were 1,132,000 bales of 500 lb. each. Egyptian cotton resembles Sea Island cotton and is used for fabrics requiring a smooth finish and silky lustre. It is, moreover, of a brownish hue and is, amongst spinners, considered a specialty.

As already shown, the imports of Egyptian cotton into Great Britain in 1901 were 389,371 bales, and in 1892, 487,474 bales. The United States also take some Egptian cotton. In 1900-1901 the imports into that country were 69,571 bales.

A few of the points in favour of re-establishing a cotton industry in the West Indies may be mentioned. There are large stretches of cleared land, formerly under cultivation in sugar-cane, well adapted for the cultivation of cotton. The soil and climate have, long ago, been proved to be favourable; and the present labour supply, especially in such islands as Bardos, Montserrat, Antigua, and St. Kitt's, is likely to be equal to the demand, and available at a lower cost than anywhere in the United States.

The variety of cotton suitable for cultivation in the West Indies is the "Sea Island" cotton. This is a special kind almost identical with Egyptian cotton and usually commands the highest price.

It may be added that the planters regard favourably the prospect of at least a partial return to cotton planting in these colonies. It will readily fall into line with the estate routine with which they are already familiar, and it will require almost identically the same kind of field preparation as sugar. Irrigation and the use of expensive artificial manures will be unnecessary. If the whole of the cotton seed that is produced were converted into meal and this were fed to animals and the resultant manure applied to the land, it is probable that no other fertilizers would be required.

It is also in favour of a cotton industry that expensive machinery and buildings are not required, and that the crop could be grown and exported within a period of about six to eight months from

the time of planting. It is probable that a central ginning factory costing a few hundred pounds would be capable of dealing with the crop produced on a comparatively large area.

General Notes.

British Output of Coal, 1902.—The Home Office has issued an advance proof of the Tables relating to the output of coal during the year 1902, from which it appears that the output of coal, which was 219,037,240 tons in 1901, was 227,178,140 in 1902, showing an increase of 8,140,900 tons. This increase was distributed in the twelve inspection districts as follows:—East Scotland, 826,621; West Scotland, 538,963; Newcastle, 783,484; Durham, 489,050; York and Lincoln, 990,259; Manchester and Ireland, 415,021; Liverpool and North Wales, 306,498; Midland, 1,338,298; Stafford, 319,408; Cardiff, 960,868; Swansea, 558,602; Southern, 613,828. The number of persons employed was 825,401, an increase of 18,666. The increase in the output of coal is at the rate of 3·72 per cent., and the increase in the number of persons employed at mines is at the rate of 2·31 per cent.

Chemical Congress at Berlin, 1903.—The Fifth International Congress for Applied Chemistry will be held in Berlin from June 2nd to June 8th next. The general meetings will take place in the large hall of the building of the Imperial Parliament, and meetings of the several sections will be held in the Committee Rooms. Previous congresses have been held (1) at Brussels, 1894 (2), at Paris, 1896 (3), at Vienna, 1898, and (4) at Paris, 1900.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at Eight o'clock:—

April 22.—"Modern Bee-Keeping." By Walter Francis Reid, F.C.S. Elliott Downs Till, late Vice-President of the British Bee-keepers Association, will preside.

April 29.—"Automatic Wagon Couplings on British Railways." By T. A. Brockelbank.

May 6.—"The Construction of Maps and Charts." By G. J. Morrison.

May 13.—"Preservation of the Species of Big Game in Africa." By E. North Buxton.

May 20.—"Fencing as an Art and an Historic Sport." By Egerton Castle, M.A.

Indian Section.

Thursday Afternoons, at 4.30 o'clock:—

April 23.—"The Province of Sind." By Herbert Mills Birdwood, C.S.I., M.A., LL.D. The Earl of Lytton will preside.

May 14.—"The Province of Assam." By Sir Charles James Lyall, K.C.S.I., M.A., LL.D. The Right Hon. Lord George Hamilton, G.C.S.I., M.P., will preside.

Colonial Section.

Tuesday Afternoons, at 4.30 or 5 o'clock:—

May 5, at 4.30 p m.—"The Lagos Hinterland: its People and its Products." By Major J. H. Ewart.

Applied Art Section.

Tuesdays, at 4.30 or 8 o'clock.

April 28, 7.30 p.m.—Visit to the Whitefriars Glass Works. Paper by Mr. Harry Powell on "Modern Table Glass." (Special tickets required.)

May 19, 4.30 p.m.—"Mezzotints." By Cyril Davenport, F.S.A.

Cantor Lectures.

Monday Evenings, at Eight o'clock:—

W. Worby Beaumont, Mem.Inst.C.E., "Mechanical Road Carriages." Four Lectures. April 27, May 4, 11, 18.

MEETINGS FOR THE ENSUING WEEK.

Monday, April 6.. National Service League (at the House of the Society of Arts), 8 p.m. Colonel Watson, "National Service as Contrasted with Conscription."
Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Robert J. Thomas, "Road Maintenance and Administration."
Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Dr. W. Newton, "The Manufacture of Iodine from Nitrate Liquors." 2. Mr. Watson Smith, "New Modification of Coffignier's Prussian Blue Reaction, and a possible Application." 3. Dr. A. Dupré, "The Explosion of Potassium Chlorate at St. Helen's."
Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. John Tuckwell, "Modern Theories concerning the Composition of Holy Scripture."

Tuesday, April 7. Asiatic, 22, Albemarle-street, W. 3 p.m.
Anglo-Russian Literary Society, Imperial Institute, South Kensington, S.W., 3 p.m. Mr. F. P. Marchant, "Prague and the Czechs."
Alpine Club, 23, Savile-row, W., 8½ p.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. Percy John Cowan's paper, "American Locomotive Practice."
Photographic, 66, Russell-square, W.C., 8 p.m.
Colonial Institution, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Mr. B. Kidd, "The State in Relation to Trade."

Wednesday, April 8...Geological, Burlington-house, W., 8 p.m.
Japan Society, 20, Hanover-square, S.W., 8½ p.m. Mr. M. Tomkinson, "A Gossip in Japanese Art."
Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.
British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

Thursday, April 9...Mathematical, 22, Albemarle-street, W., 5½ p.m.

Journal of the Society of Arts,

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FRIDAY, APRIL 10, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

APPLIED ART SECTION.

Messrs. James Powell and Sons have kindly invited the Applied Art Section to visit the Whitefriars Glass Works, Tudor-street, E.C., on Tuesday evening, April 28th, from 7.30 to 10.30 p.m. A short paper, "On Modern Table Glass," will be read by Mr. Harry Powell, and the processes will be explained in the glass-house.

The accommodation is strictly limited and 100 tickets only will be issued. These tickets will be issued in order of application to Members until the number is exhausted. Each Member is entitled to apply for one ticket, which will be transferable.

No one can be admitted without a ticket.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday afternoon, March 17, 1903; Sir George Birdwood, K.C.I.E., C.S.I., Vice-President of the Society, in the chair.

The paper read was—

ARTISTIC FANS.

By Miss Hannah Falcke.

The paper I have the pleasure of submitting to you this afternoon is on a subject which, although it has been much discussed, has really not received the attention it deserves. Old china, miniatures, engravings, and a host of other *objets d'art* all have their admirers; the artistic fan, however, though a fascinating object, has been undeservedly neglected by many connoisseurs.

The lack of enthusiam as regards this interesting subject is to me incomprehensible, for the study of artistic fans is no narrow one. It necessitates a knowledge, not only of the various fabrics used in the manufacture of this article of the toilet, but of the painters of various periods and nationalities who decorated them, and an accurate remembrance of the main incidents in history and mythology, in order to enable the student to understand the subjects depicted on the leaf.

What I may term the "genesis" of the fan dates to so remote a period that it cannot be accurately traced, and all that has been written and said on the subject is mere conjecture.

Uzanne, in his elegant and charming little book, entitled "L'Eventail," expresses himself as follows in regard to our knowledge of the origin of the fan:—

"The origin of the fan is still shrouded in the most unpenetrable mystery. It is in vain that pens have absorbed huge bottles of ink, and have composed ingenious essays, curiously interspersed with quotations from precious documents or citations in all languages to explain its origin. The point of interrogation is always omnipresent like a diabolical hieroglyphic sign, on which the erudition of archæologists is sarcastically inscribed."

In view of this statement there is nothing left for me to do but to place before you some points of information, true or fictitious, historical or mythological, which are to be found in literature, and leave my intelligent listeners to separate for themselves the chaff from the grain, or fact from mere conjecture.

That fans are indeed a very ancient institution is proved by their mention in the Old Testament as implements employed for winnowing.

In Chinese records, moreover, it is stated that during the Chow Dynasty, 1106 B.C., fans were used to keep the dust from the wheels of the chariots; at this time they were doubtless nothing more nor less than dried palm leaves, for ivory fans were not known in China until two centuries later, namely 991 B.C., and since then such diverse materials as dragon-skin, tortoise-shell, bamboo, oil-silk, and rice paper have been employed in their manufacture.

Some of the older authors state that in China at a remote period fans or rather hand screens were made of peacock feathers, the tail feathers being mostly employed for this purpose. It is related, however, that in 650 A.D., the Emperor Kao-Tsong heard the cry of the pheasant which is an omen of good luck; he therefore henceforth resolved to use only a fan composed of the tail feathers of this bird.

A story is told of a mandarin's young wife who wished at the deathbed of her husband to swear that she would always remain true to his memory, but he said "No, only promise me you will not marry again until the soil that covers my last resting place is dry." The rest of the story is like the well-known tale of the widow of Ephesus. A lover appears, and the widow true to her promise daily visited the grave, but not to weep, for she was busily engaged in fanning the soil with her fan, so that it should dry up quickly and she could marry her lover without breaking the solemn promise made to her late husband.

The custom of using fans in Japan, as far as can be ascertained, dates back to the sixth century A.D., and in that country every person from the Mikado on his throne, downwards in successive grades, princes, noblemen, courtiers, priests, sages, women, dancing-girls, even children, all wielded a fan of special design according to his or her rank, profession or social standing. It has played an important part in life in Japan past and present, being an article of many uses and multifarious duties. As in Egypt, it was borne aloft in times of war as a standard. The "War Fan" was used by generals and commanders for directing the movements of the troops during action, and, if necessary, could be utilised as a shield for defence; it was strongly fashioned of double leather, sometimes even of wrought iron lacquered, and it usually possessed a long iron handle.

In Japan a fan was wielded by the umpire of wrestling matches, and this custom is still in vogue. Lovers were wont to exchange fans as tokens of fidelity, and friends regarded the gift of a fan as a sign of liking and esteem. In the land of the Rising Sun it is used to waft cool air to the heated countenance, and to fan the charcoal flame used for cooking. Held above the head it shields the face from the fierce rays of the sun, and in the street it is waved in greeting or salutation. The nurse, in Japan, wafts a fan, also, gently to and fro over her infant charge to lull him to sleep and to keep off the insects.

At all times Japanese artists have delighted in expending their skill in painting on the open fan, and the present artists do the same. Their productions are sketchy, and perhaps, according to our Western notions, somewhat grotesque, but their touch is delicate and their colouring good. A charming custom prevails in Japan at artistic social gatherings. As a means of entertaining the guests and passing away the time, the brothers of the brush often sketch little scenes, groups and incidents of interest or history on fans, which are subsequently passed round and exchanged, and carried away as treasured keepsakes.

I must not, however, enlarge further on the fan and its uses in the Far East, for it is a common article in the hands of every class, and has a place in every household. Indeed it serves so many purposes that a volume might be filled with a description of its uses.

There are two hypotheses as to the manner and means that suggested the folding fan, and both have to do with the observation of Nature.

According to one theory, it is said that an artisan of Tam Ba was seated one night at the door of his house, idly fanning himself while watching the flight of the bats overhead. The idea suddenly occurred to him to fold the stretched material of the fan in imitation of the bats as they opened and shut their wings, and he thus originated the folding fan, which is called in Japanese "komori," a bat.

The other theory is equally fanciful, but perhaps the more probable. There is no doubt that the flat fan was originally simply a palmetto leaf, and the gentle breeze made by its moving to and fro on the parent tree may have suggested the use of a single leaf for the like purpose. It is said that the folding fan was likewise suggested by the palmetto leaf, for, undeveloped, it is pleated and packed, delicately and compactly, by Nature's deft hands, and the clever Japanese, ever ready to seize and imitate something fresh, took advantage of the copy already prepared for them, and in 750 A.D. their supple fingers invented the folding fan.

Fans were already used in Egypt in the 13th century, B.C., as is clearly proved by the frescoes that ornament the Palace Temple of Medinet-Haboo at Thebes; on these frescoes Rameses III. is depicted, surrounded by princes and courtiers bearing hand-screens, semi-circular in form, bright in colour, and mounted on long handles. The fan at that period was, it must be noted, no feminine adjunct to the toilet, its use being only permitted to leaders of armies, princes, and high dignitaries, by whom it was borne aloft as a sign of distinction, and, in the case of warriors, as insignia of command. Ostrich feathers were largely used for making these stately fans.

India, likewise, claims the right of having first invented the fan, and there is no doubt that, though we are not in a position to confirm or deny the assertion, the fan has for ages

been used in this country of mystery and charm, of gay flowers and luscious fruits, of jewels, wealth, and luxury. In a country so hot and enervating as India the fan was almost a necessity of life. In Hindostanee the fan is called "Pank'ha," and to this day the term is applied to the huge swinging screens suspended from the ceilings in India and worked by natives duriug meal-times to cool the air for European inhabitants and Indians of wealth and high degree. In India fans were made of carved ivory, of tortoise-shell, and sandal-wood, of dried grasses, bamboo, palm leaves, straw, peacocks' feathers, and muslin; also were they made of thin sections of wood joined in the centre, and with a handle at either end so that when the two handles were brought together the fan opened like a circle, and when brought together in the opposite direction it closed up flat.

The fan was also known to the ancient Medes and Assyrians; and the Persians made use of the long handled square or spherical fan of the hand-screen variety. The kings of the latter country when taking the field against an enemy, were wont to be accompanied by a sacred fire carried on a splendid chariot drawn by four high-stepping, white steeds, and followed by a bevy of youths, 365 in number, clothed in yellow. So holy was this fire considered, that it was thought that the breath of a man would defile it, and it was therefore always kept alive by a special fan. It is probable that the 365 youths were emblematical of the days of the year, and that the fire represented life.

From Asia, by way of Asia Minor or Egypt, the fan made its way into Europe.

Greece was the first country in Europe to adopt the fan, and that must have been at a remote date, for it is gravely asserted that the Sibyl of Cumae was in the habit of wafting a fan to and fro whilst delivering her momentous oracles.

The first fan used by the Greeks was simple in form, but like most things Greek, very elegant. It consisted merely of a pair of birds' wings, joined and fixed on to a long handle. It was used by the acolytes in the temples to drive the flies away from the sacrifice, and to cool the air. In the Temple of Artemis the vestal virgins utilised palm leaf fans to fan the Sacred Fire, and branches of myrtle and the leaves of the Oriental plane-tree were likewise used for the same purpose.

It is a curious fact that, in contradistinction to the custom in vogue in Ancient Egypt and Japan, the fan in general was, in Greece, at first only used by slaves to cool the atmosphere, and thus contribute to the comfort of their masters.

A few days ago when passing through the Greek room at the British Museum, my attention was specially attracted to the exquisite terra cotta statuettes found in the tombs of Tanagra. Three of the female figures carried fans, two of them being of the palm-leaf shape and one circular in form. One little male figure, also, carried an enormous fan, round in shape, and covered by long feathers. These statuettes are, as you know, referred to the 5th and 4th centuries before Christ.

From Greece the fan by gradual stages crept on to Italy.

There are extant in our Museums paintings on antique Etruscan vases of figure subjects, with accessories in the shape of fans. These are always of the hand-screen order, with long handles, and are square, pear-shaped, or semi-circular, and covered with feathers. The presence of fans on antique pottery proves how ancient these ornaments must be.

At the dawn of Christianity the first converts at Rome were in the habit of using fans, and some documents of that era mention the circumstance that, during the services held secretly in the catacombs, deacons stationed at either end of the altar incessantly waved to and fro large fans, to cool the close atmosphere and drive away the flies that might otherwise have settled on the sacred bread or have fallen into the chalice. This custom actually continued in vogue in the Church of Rome until the 14th century A.D.

Fans became very popular in Italy during the 12th century, and were made of feathers either in bunches, or fastened in a semicircle on to a frame. The feathers employed were those of the ostrich, peacock, parrot, or Indian crow. They were of the hand-screen form, were made in the East, and exported thence to Venice and other ports for distribution throughout Europe. The handles were made of ivory, or even of gold embellished with precious stones.

During the 15th and 16th centuries the fan in Italy became a most extravagant article, the kinds most fashionable being the feather, the folded, and the hand-screen fan. Ladies were in the habit of wearing their fans suspended from the waist by a golden chain, as was the housewife's bunch of keys, and this mode may still be observed in some parts of Italy at the present time.

During the 16th century fans were articles

of fashionable attire, not alone of ladies but of gentlemen, and were dainty little articles, the body being of paper beautifully painted on both sides and the small handle made of wood. The favourite subjects chosen for decoration were love scenes from literature and mythology, an explanation in verse being sometimes inscribed beneath.

More costly materials such as kid or lamb skin, vellum or satin, were also utilised for fans, and these were painted with no mean skill, the best artists not considering it beneath their dignity to decorate a fan. The sticks or bouts of the best fans were fashioned of tortoise-shell, mother-of-pearl, or ivory, the latter being so beautifully pierced and carved as to resemble the finest lace. It was at this time that *L'éventail plissé* was introduced into Italy.

In 1730 the fan in Italy was made entirely of ivory, carved or plain, and in some cases, as in the fan I now have the pleasure of introducing to your notice, three plaques of painted satin, beautifully executed, were skilfully appliquéd on. This fan also is of the same date and both are known as *l'éventail brisé*. The sticks and mount are in one, as you will observe.

By this time the fan had become so popular in Italy that it was equally common in the hands of the peasant and the duchess.

The two countries of Italy and France have ever had near commercial interests, thus it came to pass that the folding fan, called *l'éventail plissé* or *esventoir*, was introduced to the French by the Italian perfumers in the time of Catherine de Medici, and soon became the rage, the hand-screen of Eastern origin being speedily abandoned.

France has produuced some of the most beautiful fans possible from the 14th to the 19th century. The lightness and delicacy of the ornament, together with its beauty and elegance, seem to appeal irresistibly to a nation at once so tasteful, and so sentimental. Indeed, the temperament of the French has shown itself at its best, and their artistic skill at its highest in their treatment of fans, for in no country in the world has the subject been so lovingly and gracefully handled.

Almost from the time of their introduction into France, the fan sticks were made of ivory, mother o' pearl, and tortoise-shell; they were richly carved, and inlaid with gold, silver, and other metals. Sometimes the sticks were made of gold, and enriched with diamonds, rubies, emeralds, and other precious stones, or with pearls; filigree silver was also in high favour The material, of which the leaf was composed, varied exceedingly, and comprised chicken-skin, swan-skin, kid, and lamb-skin, as well as vellum, satin, silk, and paper; it may be imagined, that with such a choice of substances, many diverse effects could be obtained.

An old French book mentions that, in the reign of Charles V. of France, that monarch, about 1370, possessed a folding fan, bearing on its leaf the arms of France and Navarre, and having an ebony handle.

During the reign of Louis XIII., Anne of Austria introduced many Spanish fashions into France, fans made of scented wood amongst them. The fashion, however, did not last long, for the artistic eye of the French rebelled against the inferiority of the Spanish workmanship, the coarseness of the carving, the crudity of the colouring, and the ungracefulness of the drawing; under these circumstances it is not surprising to learn that the trade soon dwindled, and finally collapsed entirely.

During the reigns of Louis XIV. and Louis XV., the arts and crafts flourished exceedingly, and fans were not neglected. The leaves of chicken-skin, vellum or parchment were painted in figure or pastoral subjects by such celebrated artists as Watteau, Lancret, Detroy, Vien, and even the celebrated Greuze; landscape and pastoral subjects were painted by Joseph Vernet, Boucher, Baudoin, and Lebrun; all lent their splendid talents for the adornment of these ladies' toys.

The fan now shown on the screen is of the time of Louis XV., and this one which is called "The French Marlborough Fan," exhibits on the side shown to you three vignettes, depicting, respectively, the parting of the Duke and Duchess of Marlborough on the departure of the former for the scene of war; the Duchess watching her husband from the tower; and the Duke's tomb.

On the reverse side the 19 verses of the famous satirical song, entitled "Malbrouck," are printed. They were composed after the battle of Malplaquet in 1709, when the duke was reported to have been killed. This song maintained its popularity in various parts of Europe for a century and more.

During the time of Louis XV. there lived a family of four brothers, named Martin. One of them was an able chemist, and invented a wonderful varnish. It was delicate and transparent, and possessed the lustre and hardness of fine porcelain glaze. The brothers being coachbuilders, at first employed this

varnish to finish off the carriages they made, but later on it was used for the purpose of varnishing painted fans. It is asserted that the inventor of the varnish, ornamented the fans as well as varnishing them, but this I think is improbable. In any case this varnish, called "Vernis Martin," was used to glaze all the best fans of the period.

Unfortunately the secret of its manufacture, jealously guarded during the inventor's life, died with him, and though many attempts were made to imitate it, they were unsuccessful. During this period the sticks were smaller and more delicate than in the preceding reign, and perhaps the richness and loveliness of colouring and design of the leaf was improved by the introduction of Chinese sticks, or sticks ornamented in the Eastern style. Some fans were painted by a French artist, finished by Martin, and the sticks subsequently decorated by an Oriental painter. Other fans, as the one I now show you were of ivory *brisé*, the leaf and stick being combined; this particular *éventail* is interesting from the fact that it tells its own tale. It is evident that the fan itself was of French workmanship, the decoration of the upper part was probably undertaken by a Flemish painter in France, the sticks or bouts were ornamented by an Oriental artist, and finally, the varnish was put on, but evidently by an imitator of Martin's method, or by one of his pupils, as it lacks the translucent appearance of real "Vernis Martin." I also have pleasure in showing you another fan of the same period, but somewhat larger; the mount in this case, however, was the work of a French artist, as will be seen. The period of Louis XVI. was also a luxurious one. Specimens are very scarce at present as they were small, delicate, and easily broken. The sticks were beautifully carved in figures, horses and chariots, dogs, birds and trees, and then coloured true to nature. The leaf, as a rule, was of a light and flimsy material, sometimes spangled, and in very rare cases painted by artists of renown.

Then followed the dark and dreadful days of the Revolution, when Louis XVI., the heavy and foolish, and his consort Marie Antoinette, the beautiful and light-hearted, suffered death on the guillotine. All good taste died during this time, and the art of fan-making languished. Luxuries of every sort savoured of the hated aristocrats, and no woman would have dared to use a jewelled or gold-handled fan. Those fans that were made at this time were of coarse paper, and reflected the temperament of the people. *Liberté, egalité, fraternité*, was the cry, and crude drawings of current incidents figured on the fans. The meeting of the National Assembly, the murder of Marat in the bath by Charlotte Corday, &c.—these incidents depicted on the fans showed, as in a mirror, the mind of the people. In this connection, it is interesting to note that, on one *éventail*, Charlotte Corday is represented carrying a dagger in one hand, and a fan in the other.

Again there was a lull, and again there was a revival of the art of fan-making during the Empire period. The fans of this time were small, and either made of horn painted with flowers, or muslin or silk gaily spangled (like this one on the screen). A few, such as the two I now show you, were, however, larger.

There were fans also that reflected the feelings of the French for Napoleon, such as his portrait, with folded arms and downcast gaze, or his likeness in the well-known cocked hat and grey riding coat. There were fans, too, that exhibited a martial spirit, and these were decorated with cannons and other cruel instruments of war, the escutcheon of the Emperor, the flag of France, or the fleur de lys. A few, on the other hand, were painted with classical subjects.

During this time also, the fan was used by hostesses as a token of greeting, salutation, or welcome to their guests. Many degrees of intimacy were thus expressed from the formal stately wave of the fan to the playful rap on the arm or shoulder of the welcome friend.

In the year 1827, the fan was indirectly an important factor in the conquest of Algeria by the French. The Dey of Algiers insulted the Consul of France by giving him a blow with his fan of peacock feathers. War was declared, and Algiers became the property of the French.

In 1829 the taste for luxurious fans revived, and fans in imitation of those of the time of Louis XV. again became the fashion, but they never attained their former excellence; the master hands were gone, the spirit that animated the period of Louis XV. could not be revived, and the result was a failure, because, although expensive materials only were used, the taste of the former periods was lacking.

Spain has ever been the land of romance and gallantry, and the home of song, music, and the dance. The mandoline and guitar are played by enamoured swains beneath the windows of their sweethearts. The music is

accompanied by tender love songs or serenades, and dark-eyed beauties shielded from view by their large fans glance forth into the night to ascertain who it is that is serenading them. When the first fans were introduced into Spain, they were eagerly adopted by the lovely and coquettish ladies, and to this day the fan is considered an essential part of a woman's dress, and is her constant companion.

Though the Spanish fans are by no means models of artistic excellence, there is no country on the face of the globe where they are so gracefully wielded. The *abanico* is really an important weapon in the mimic warfare of coquetry and flirtation in the hands of an accomplished senora or senorita. Mrs. Salwey, in her clever book on fans, thus expresses herself on the fan of Spain and its uses :—

"The fan in the hand of a Spanish lady knows no rest; it is perpetually in motion, portraying the feelings and thoughts that are passing through the mind of its owner. It is her interpreter, often unconsciously. It is always in her hands; in church, in places of amusement, when visiting or walking, and on every occasion. There is a complete language of the fan which is studied with great care and persistence until it is thoroughly acquired, and it is almost a necessity to study this accomplishment."

Later on the fans, or *abanicos*, in Spain, following the lead of other European lands, were made to fold, and they possessed one distinct advantage over the others, namely, that they were made to open both from right to left and left to right. The little ivory fan I here show you is a specimen of this style, and has four distinct sides.

I find that during the 15th century, and even later, the fan was used in Spain by men as well as by women; indeed, at the bull fights, the fan was frequently employed by the toreros to flap in front of the bull and thus rouse his slumbering ire and cause him to charge his insulter. Be this as it may, it strikes me from what I have read on the subject that the use of the fan by toreadors on these occasions was really only a means of showing their courage in the face of extreme danger by an affectation of indifference and frivolity.

It is curious how a national sport, pastime, or custom, becomes impressed on the art of a country, or even on articles of jewellery or wear. Now, perhaps fans come under the heading of both "art" and "wearing apparel," and therefore the fan is in Spain impressed with the spirit of the country, for whereas other lands have more pleasing subjects to portray, the Spanish fans are mostly painted with scenes from the arena, and I fear this subject does not appeal to tender-hearted Englishwomen. True, other subjects — the dance, the serenade, and so on, are depicted on Spanish fans, but the bull fight is the most popular one. The mother-of-pearl sticks are gaily decorated.

A printed Spanish fan of the 18th century, though crude in colour and imperfect in drawing, is interesting from the circumstance that it bears the words *Origen de los Abanicos;* Psyche is depicted asleep on a couch under a tree. Cupid is standing by bearing in one hand his arrows and in the other a wing torn from the shoulder of Zephyr, who is disappearing in the distance.

Of the German and Dutch fans I can have little to say in this paper as they are not particularly interesting. Perhaps I have not seen enough of them to be a good judge. They are mostly illustrated by pastoral subjects, but these are heavily treated. Historical subjects have also a place in the decoration of these fans.

English fans are said to date from the year 1307. Thus it will be noted that fans made their appearance almost simultaneously in the 14th century in France, Italy, Spain, and Great Britain.

During Queen Elizabeth's reign fans became the height of fashion; they were of an extravagant description, the sticks being made of mother-of-pearl, inlaid ivory, or gold and silver studded with pearls, rubies, and emeralds.

After Queen Elizabeth's death, 27 fans were found to have been entered in the inventory of her wardrobe.

Now good Queen Bess had a strange but refined notion that a fan was the only gift permissible from a subject to his sovereign. Sir Francis Drake presented the Queen with one. It is described as being of red and white ostrich feathers, and the gold handle was decorated with a half-moon of diamonds and pearls, which formed a frame for a miniature of herself.

Another fan presented by the Earl of Leicester was of white feathers. The handle was likewise of gold and was thickly jewelled, bearing a lion rampant with a muzzled bear beneath its foot; still a third fan was of swansdown, its handle representing a golden monster, with head and breast of mother-of-pearl.

I must not forget to mention that at this time fans were by no means monopolised by women, though the use to which they were put

by men was by no means too gentle, for Aubrey says:—"The gentlemen had prodigious fans, and they had handles at least half a yard long; with these their daughters were oftentimes chastised."

As articles of use, wear, or ornament become more widely known they become universally adopted, or, in the phraseology of the past, "the mode," and thus it happened in England that by the latter part of the 16th century fan-making had become an important trade in England, though the fans were not so artistically made as in France until the revocation of the Edict of Nantes, in 1685, when numerous French fan-makers came to England, and by introducing their industry, improved the taste and style of fans here.

This fan shown on the screen is of English manufacture, and dates from early in the 19th century. The fans of former centuries are a faithful mirror of passing events, and a truthful recorder of history, music, politics, social customs, sports and poetry. There is scarcely an occurrence of importance that has not been painted or printed on a fan. Gay subjects, grave subjects, heroes of the sword and pen, each and all have been portrayed on fans. The most striking events of ancient history have been transferred to chicken skin or vellum, or immortalised on silk or paper. An account of the fans of the 18th century would form a comprehensive history of the period, and the late Lady Charlotte Schreiber's wonderful collection, given by her to the British Museum, is representative of this time.

I feel that no paper on fans would be complete without some reference to this remarkable collection, but, as the time at my disposal is drawing to a close, I must content myself with the mention of a few, together with the names of their makers and publishers. With the exception of one or two, all Lady Charlotte Schreiber's English fans were printed on paper or skin, plain, or coloured by hand. The *éventails* I am referring to comprise historical, geographical, and botanical fans; riddle fans, and fans representing scenes from Shakespeare, mythological subjects, portraits of Milton, Wellington, and Napoleon I.

Very curious is one on which a punning bill of fare of a wedding dinner is printed. Melancholy soup with crooked sauce, the divine part of a man boiled, and a Dutch Prince in a pudding are among the good things set forth on the menu.

The Love Scene is a pretty fan, it was issued by "Clarke & Co., Fan Makers to Their Royal Highnesses the Duchess and Princess of Gloucester, at their warehouse, No. 26 Strand. N.B.—Inventors of the Pockett Sliding Fans."

Lady Charlotte Schreiber's collection likewise contains a garden scene, which was issued by Chassereau, and which is dated 1741.

"Boys with tops" and "children with battledores" are two pretty printed paper fans the production of "A. Poggi, St. George's-road, Hyde-park."

There is also a History of England, a duplicate of which I am fortunate enough to possess.

There is a highly interesting allegorical fan on the marriage of the Princess Mary with William Prince of Orange. This fan was published by M. Gamble, who thus advertised it in *The Craftsman* of August 25th, 1733.

"The Orange Fan, with a letter to the lovely She who has more than 30,000 charms. . . .

> "Once more the Orange joins the British Rose,
> And fragrant sweets they mutually disclose.
> Entwin'd by Nature's bonds, their charms unite,
> And from the Foil the Jewel shines more bright."

Another fan on the subject, but differently treated, was produced by "Jonathan Pinchbeck, Fan Maker, the Fan and Crown, New Round Court, Strand."

There is no doubt that these two fan makers were rivals, as will be gathered by the following advertisement, which appeared in *The Craftsman*, of September 22nd, 1733:—"The *Original* Loyal Nassau Fan, or Love and Beauty triumphant." A fan representing Bartholomew Fair, is inscribed: "Published as the Act directs by J. F. Setchel, 23, King-street, Covent-garden."

The most artistic and neatest trade-card of a fan maker, is the following:—"B. Coker, Fan Maker, Wholesale and Retail, 118, Fleet-street, London. Fans neatly repaired." This card is small, and is decorated with a draped classical figure holding a shield on which the above lettering is inscribed.

In trying to cover so extensive a field as the history of fans, I have of necessity been forced to be brief in my descriptions, but I trust that I have been able to give to my hearers some faint idea of the great interest of the subject.

There are so many points worthy of notice that I felt it was almost hopeless to touch upon more than a few of the most representative of these. The great and abiding charm of the fan is connected with its personal associations, and however ornamental it may be, however great its artistic value, usefulness is never entirely overlooked. The fan is an

object loved by its possessor, and when we look at any collection of fans we cannot but feel how great is this personal charm.

Each age has left its mark in the pattern of the fan. Events of passing interest as well as those of historical importance have been recorded, and artists of repute have been found to ornament them. The variety of styles is so great that there cannot fail to be some to interest all tastes.

I hope that in the present day we shall never let this artistic feeling die out, for we may be sure that in the future, whatever fluctuations there may be in fashions, the fan will always hold a high position in popular esteem.

DISCUSSION.

Mr. A. Ross Collins (Master of the Worshipful Company of Fan Makers) said he did not propose to criticise anything which Miss Falcke had said in her interesting and able paper, because there were others present more capable of dealing with that than he was. He would, however, remark that Miss Falcke made no reference to the Fan Makers' Company, which, for so many years, had the control of the fan-making industry in England, and which, since its resuscitation in 1876 and 1877, had been making such gallant attempts to foster the interest of fan-making in England, efforts which had met with a good deal of success. It was well known that a few centuries ago each of the trades of London were really represented by one of the City Companies, acting under charter, and the Fan Makers' Company was one of the number. That company had very full powers in the direction of the management of the industry. He believed he was correct in saying that it was absolutely necessary for every body connected with fan-making, either as a seller or as a manufacturer, or assistant or apprentice, to be connected with the Fan Makers' Company. Those powers even went as far as dealing with right of entry and search and seizure, with somewhat severe fines and penalties on people who dealt in fans which were not of British manufacture. It appeared from a perusal of the records that the company had a difficulty in carrying out its duties because of the amount of competition introduced, chiefly from France and Italy. The bye-laws appeared to have been frequently altered in order to give increased power to deal with such competition, and to prevent the importation continuing, as it had such serious effects upon the English manufacturers. Despite that, the competition grew, and at length the removal of the duty practically killed the industry. Though the Fan Makers' Company on several occasions applied to Parliament to re-impose the duty the request was never granted, and partly on that account the industry in England nearly died out. At about the year 1876 the Fan Makers' Company had decreased to a very small number, and then steps were taken to resuscitate it. The Chairman had alluded to the exhibitions which the Company had arranged, and he was glad that had been referred to, because the Fan Makers' Court came to the decision that such was the only way in which they could awaken interest in the matter, and renew the artistic abilities of the English people in connection therewith. The three exhibitions which were held under the Company's auspices caused considerable pleasure and surprise, by reason of ladies and gentlemen from different parts of the country entering the competitions. The Company was able to offer some substantial monetary prizes. In addition, the freedom of the Company was now held by many ladies as well as gentlemen. At one or two of the exhibitions, the Princess Louise became a contributor, and her late Majesty, Queen Victoria, once or twice lent the Company some very valuable fans from her own private collection. The author of the paper had remarked that the fan was about the only article which a monarch could receive from a subject. He believed that was the case, because the Fan Makers' Company had had the honour of presenting to our late Queen a fan which was entirely of British manufacture. Prior to the resuscitation of the industry, it was impossible to procure a fan exclusively British, including the design. Quite recently, Queen Alexandra did the Fan Makers' Company the honour of carrying with her, on Coronation Day, a fan which also was entirely of British manufacture. That, and also the one presented to Queen Victoria, was made by Miss Oldroyd, a lady holding the freedom of the City. He was very glad of the opportunity afforded to him of showing that the Fan Makers' Company was a living reality, and that it had been, since 1876, doing its best to interest people in that very pleasing art, and was hopeful of doing even more in the immediate future.

Mr. J. Ettlinger (Foreign Warden of the Fan Makers' Company) said that he could not agree with Miss Falcke that after 1829 fan making ceased to be artistic. In France, in Louis Philippe's time, and since, great artists painted fans. He referred to paintings of fan leaves done by Ingres, Horace Vernet, Soldé, Gimbel, and Lemaire. Within recent years feather fans were made more artistic. Whilst formerly, feathers were used for screen fans only, ostrich, peacock, argus, jay, and ostrich feathers are now artistically mounted as folding fans, as could be noticed in Messrs. Liberty's cases in the exhibition now on view in the library below. Then within the last 50 years the use for fans of beautifully designed laces had greatly developed. Specimens of fans mounted with Belgian, Irish, Honiton, and Normandy laces, would be found amongst the exhibits of Messrs. Marshall, Liberty, and Marcot. About 25 years ago the teachings and the example of William Morris and Mr. Liberty, revolutionised applied art all

over Europe. Their influence, felt everywhere, could not but make its impression on the decoration of fans. Hence new colourings and new designs were introduced which can also be clearly perceived by examining the exhibits. Notwithstanding the criticism he had expressed, he considered that Miss Falcke had read a most interesting paper, and only regretted that she did not carry her investigations further.

The CHAIRMAN said:—This was the first time Miss Hannah Falcke had ever appeared before a public audience, and she had felt very nervous about it; but in thanking her on behalf of all present for the instructive and interesting paper with which she had favoured them, he could not forbear remarking that, admirable as it was in matter, it was not less so in the manner of its delivery. There was nothing in it to criticise; but Miss Falcke had confined herself, as she was asked to do, to the artistic aspect of the question; and all he proposed to do was to supplement what Miss Hannah Falcke had said in that view of the subject by an inquiry into the origins of fans and of the symbolism and sanctity attached to them: and for this purpose he would reexamine the etymology of the word fan, and of the words by which the fan was known in Persia and India, &c.; and re-examine also the names given, and the references made to, the fan in ancient Greece and Italy; and review the art remains of Greece and Roman, and all the monuments of ancient Egypt, Assyria, Persia, and [Buddhistic] India, on which representations of fans were found. The inductions from such a research would be at once as conclusive as they were obvious and unstrained. The word fan, or van, is directly derived from the Latin "vannus" [compare Sanskrit *vata* "wind," *vatya* "a gale," Vayu, "the Wind"—God], the name of the Roman van, or fan, for winnowing grain; which was of the same form, and "make" [*i.e.* of plaited rushes, straw, split bamboos, or such like material, painted and patterned over, or not] as the winnowing fan of the ancient Egyptians, and the modern Hindus [*sup*, *kolsup*, and *chalni*, *i.e.* *chalani* winnowing—sieve]; and was held sacred by the Romans ["mystica vannus Iacchi," Virgil Georg. I, 166], as the winnowing fan was also held sacred by the Greeks* [*liknon mystikon* Plutarch, Alex: II.], and is still held sacred by the Hindus.

The word first occurs in this country, with its Latin meaning, in the form of "uanna," as early as A.D. 800; and in the form of "fannæ," with the same meaning, in a translation of Luke III. 17, A.D. 950; as "fanne" in a translation of the same passage, A.D 1000, and in Chaucer's *Miller's Tale*, A.D. 1386; and in the final form of "fan" in Tusser's "Five Hundred Points of Good Husbandry," A.D. 1573, and, A.D. 1718, in Pope's Homer's "Iliad," V., 500:—

> "As when on Ceres' sacred floor the swain
> Spreads the wide fan to clear the golden grain."

The word in this final form is used by Chaucer also, in the Prologue to the *Manciple's Tale*, but with the meaning of "quintain"; the word here referring to the manner in which in the quintain, the transverse bar, with the board, or other "pendant" from it, moves, when struck, round the central pivot post,—like the wing, fan, or van, of a wind-mill. Milton, writes of Satan's wings, in "Paradise Lost," II., 927:—

> "At last his sail-broad vannes
> He spreads for flight."

And Keats, in "Endymion":—

> "The fans of careless butterflies."

Whether the word vane, meaning "a weathercock," is derived from "vannus," is disputable, but it is indisputable that the word vane, or van, as derived from "vannus," like its doublet fanne, or fan, is used sometimes by the older English writers for both "weathercocks," and "pennons."

The Greeks had several synonyms for the winnowing fan, but it is difficult to say by what name or names they discriminated "the little modish machine" [which is Addison's definition] we distinguish as "a lady's fan." We know from Euripides [*Orestes*, 1426-30] that the Greeks already in the 5th century B.C. recognised "the lady's fan" as of Asiatic [Phrygian] origin; but he simply describes the fan to which he refers as "a close packed circle of feathers," and does not name it. [*Cf:* attendant fanning Midas, on Attic red figured vase, 5th cent. B.C., from Chiusa, in British Museum.] We know also that by the 5th century B.C. both the fan, and the umbrella—and both as mere articles of utility, without any religious significance being attached to them—were borne by the women of the metoecs over the heads of the autochthonous Athenian ladies taking part in the sollenial Panathenaic Procession. This umbrella we know the Greeks called *skiadeion*, and *skiadiske* [*parasol*, not *parapluie*, literally sun-"shade,"] the word being in its meaning the exact equivalent of the Latin "umbrella" and "umbraculum," and of the Hindu *saiban*, "shader," the synonym of the *aftabgir*, literally "sun-catcher," the sacred processional fan-shaped parasol of the

*The myths of Bacchus [Liknites] and Hermes having been cradled in the winnowing fan may possibly be explained by the Indian habit, when a child happens to be born while the mother is working in the fields, of placing it, temporarily, in the winnowing fan [*sup*], or on any piece of matting, or cloth lying handy. The story of Sita having sprung from a furrow refers obviously to her birth in a field under the plough. Compare also the prophet Isiah, on the "call of Cyrus," lv. 8, in the Latin Version:—"Aperiatur terra, et germinet salvatorem." The English saying of a new born child having been found in a parsley-bed, or a gooseberry-bush, may have a similar origin. Some Brighton fishermen speaking to me of how when they were young their wives lived with them, and their children were born to, and bred up with them, in their boats, one of them observed:—"It seemed just as if they came up into our boats with the foam of the sea." They were inveighing against the local School Board, and the way in which they were enervating and destroying the hardy race of Sussex fishermen, and so sapping one of the natural foundations of our maritime supremacy.

Indian Mussulmans [Shia sect] and the Hindus. But we do not know the contemporary Greek name of the fan used in the Panathenaic Procession: while on the Attic and other Greek vases of the 3rd and 4th century B.C., it is often very difficult to distinguish the fan from the umbrella. Where it is distinctly an umbrella, it is either of the peaked Assyrian form, or of the dome ["rondel" of Valentijin, &c., and "arundels" of Fryer] topped Indian form [*chhatra*]; and when it is distinctly a fan, it is usually of the Indian type, determined by the fan palm frond and the peacock feather, and rarely of the Egyptian type, determined by the date palm and the ostrich feather. A similar conclusion is forced on me by an examination of the Tanagra terra-cottas of the 3rd and 4th centuries B.C., and the Pompeian paintings of the 1st century B.C, and 1st A.D. [See "Lycian" sculptures below.] We know, however, that the Greeks called the hand-fan with which they raised a fire *ripis*, and the bellows *ripidion*; and we also know that the fan of peacock feathers used at one time universally in the Catholic Church, as it still is in the Eastern Church, at the Consecration of the Elements in the Sacrifice of the Mass, was called *hagion ripidion*, and *mystica ripis*. These words, which signify "a lady's fan" in modern Greek, nowhere occur in classical Greek; while in ecclesiastical dictionaries the synonyms given for them are, "flabellum," *i.e.* "fan" or "*eventail*,* *mouchoir*, *esmoucher*, and *chasse mouche*, *i.e.*, "fly-whisk" [not fly-flapper]. All these might well be the synonyms of the Indian *murchal*, literally "peacock [tail], fanner," which is primarily a fan, and secondarily a fly-whisk, and the Indian *chauri*, literally the tail "of the *chamara*" or Thibetan yak [Bos grunniens], which is primarily a fly-whisk, and secondarily a fan. In the Western Church the fan of peacock feathers is now used in the service of the altar only in Italy; while at Rome it is also used to the present day in the sollenial processions of the Pope; and it is of the identical form of the Indian *murchal*. To me therefore it seems assured that Queen Helen's fan [in the *Orestes* of Euripides], and the Greek *ripis* and *ripidion* were variants of the Indian *murchal*. The Indian *chauri* is of the identical form, as represented on Roman coins and medals, of the sacred whisk of the Roman Augurs,—still used in the Catholic Roman Church, under the name of "aspergillum," [a term which does not occur in classical Latin], at the moment when the celebrant at High Mass utters the words "Asperges me," or when, at Easter, the antiphon "Vidi aquam" is substituted for "the Asperges."

The Latin flabellum, literally "a little breeze," is defined in the dictionaries to be "a small fan or fly-whisk"; but as a rule "flabellum," in the Latin writers, always means "a lady's fan," while the fly-whisk is discriminated by the term "muscarium" [the Greek *sobé* and *muiosobé*]. Propertius II., 24, 11, writes of "flabella" made of the tail feathers of the peacock. Martial III., lxxxii., 10-11, says of Zoilus that when overcome by the heat a pleasant coolness is wafted about him with a leek green "flabellum." Terence, *Eunuchus*, III., v. 47, uses the word obviously for a fan, although he does not describe the article:—"Cape hoc flabellum, et ventulum huic sic faceto dum lavamur:" and Plautus, *Trinummus* II., 1, uses "flabelliferæ" transparently for female fan-bearers. Martial, again, xiv., 67, under the heading "Muscaria pavonina" writes:—

> "What from thy food repels profaning flies,
> Was once a gorgeous train with gemlike eyes:"—

"Alitis eximiæ cauda superba fuit:" and xiv., 71, under the heading "muscarium bubulum":—If your clothes be soiled with yellow dust, brush it off lightly with this [ox] tail. Muscarium is explicitly the horse's tail [Vegetius IV., 1, 2, 3, and 4]; but here it is the equivalent of the Indian *chauri*, as "flabbellum" is of the *murchal*. Ovid also, *Ars Amatoria* I., 161, and *Amorés* III., 2, 38, distinctly refers to the lady's fan, but under the name of "tabella;" meaning not the voting tablet of that name, but a fan of some material, stretched on a frame, after the manner of the round Indian, Chinese and Japanese fans; which, with the Indian folding fan, described by Miss Falcke, as unfolding, when its two handles are moved in opposite directions, into a complete circle, are all derived from the leaf of the sacred water-lily, *Nelumbium speciosum*.

These few references which, however, exhaust the most pertinent that exist in classical literature, at once suggest that every variety of the sumptuary fan, known to the ancient Greeks and Romans, came to them from Asia, through the Phœnicians and the Ionians; and this is made perfectly clear by a comparative study of the fans, and fan-like standards, and other cognate objects to be observed on the monuments of ancient Egypt, Chaldæa, Assyria, Persia, and [Buddhistic] India, and in use among the modern Hindus and Indian Mussulmans.

On a bas-relief in the Boulak Museum, from a tomb at Sakkarah, of the XII. Pharaonic dynasty, *circa* B.C. 2266–2366, some shepherds are represented in a field, roasting trussed and spitted ducks over two separate fires, which are being kept alive by two shepherds each waving over the fire beside which he squats a wedged-shaped hand fan made of some matted material. There are winnowing fans lying about, and two similar articles of matted work which are difficult to describe, but which everyone who has been in India will at once recognise as the sort of hooded overcoat, or light sentry-box, which the ryots of Western India carry about with them, hooked on to their heads, when going and returning from their work in the fields, and which they use while squatted down to their work to screen them from both excessive heat and excessive rain. They might be defined as the umbrella has been defined:—"A portable pent house to carry in a person's hand to shelter him from

* In French, *éventaile* is the fan of a wind-mill, and *éventaire*, a flat basket.

violent rain or heat;" and as Herbert [1616] defines the "Yopangi":—"which riding . . . serves as an umbrella against rain, and sleeping for a bed and covering." The Egyptians evidently used the thing in the same way as the ryots of the Konkans and *mawals* of the Dakhan.

On an Egyptian stele, of *circa* B.C. 2500, now in the British Museum, a king is represented with an attendant behind him, fanning, or shading, him with a frond of the date palm, having the pinnæ of the frond plaited together.

On a coloured relief in the granite chamber at Karnak, *circa* B.C. 1333-66, are represented processional fans, and fan-like standards, semi-circular in form; like to the enormous fan-palm frond, and peacock feather fans, fixed laterally to a staff about five feet in height, still used in India for fanning great people, by resting the end of the staff on the ground by the bearer's right foot, and swinging it from the top, at arms length, backward and forward. A similar monstrous fan, or *panka* [Sanskrit *paksha*, "a feather," here referring specifically to the tail feather of the peacock] is similarly used in India without being affixed to a staff; being held by a guarded indentation in the middle of the base line; or sometimes by a little handle made, for the sake of picturesqueness, to project beyond the base line of the fan.

A winged figure, ascribed to B.C. 1333-6, reproduced by Perrot and Chipiez, "Egyptian Art," II., 349, is represented holding an ostrich feather-form hand-fan in the right hand, and a sceptre in the left. They also, in the same volume, at page 356, reproduce from a painted ceiling, to which no date is assigned, two sacred vultures, with outstretched wings, each, in both talons, grasping a long handled ostrich feather-form fan—which is neither a hand fan, nor a standard fan, but a sceptral fan. Again, in the same volume, at page 283, they reproduce from Prisse, a bas relief, of which no date is given, representing a Sphinx, overshadowed by the "winged-circle," which supports, by means of a depending hooded snake [*haji*], a hand fan, of undoubted ostrich feathers, over the Sphinx's head.

In Canon Rawlinson's "Egypt" II., 401, is the representation of a nobleman, *circa* B.C. 1300-33, bearing in his left hand a sceptral fan of ostrich feathers.

In the temple of Ramses XII., B.C. 1135, a tablet represents the departure of the god Khonsu from Thebes to the land of Bakhatana. A standard fan of ostrich feathers of the Indian *murchal* type is fixed in the bow of the boat bearing the god in his ark, and a semi-circular standard fan in the stern; both standards being inclined so as to meet over, and overshadow the ark.

At Medinet Abu is a scene of Ramses III., *circa* B.C. 1200, in his litter, preceded by processional fans of the Indian *murchal* type, and half-circle *panka* type, and also of the wedge-shaped type—here taken from the papyrus.

In Rawlinson's "Egypt," I., 531, he reproduces from Rosellini, a representation, undated, of an Egyptian nobleman in his litter, with an attendant behind him, and holding up over his own, and his master's head, one of those pent-house objects already described, but which, in this instance, is of far stronger construction, and covered with closely fitted giraffe skin.

On a "Nineveh marble," in the British Museum, from Nimrud [Calah, not Birs Nimrud] representing Assurnazirpal, B.C. 860–85, offering a libation on the hunting field, an attendant stands behind him holding an umbrella over his head, and another before him, fanning his face with a handled *murchal*.

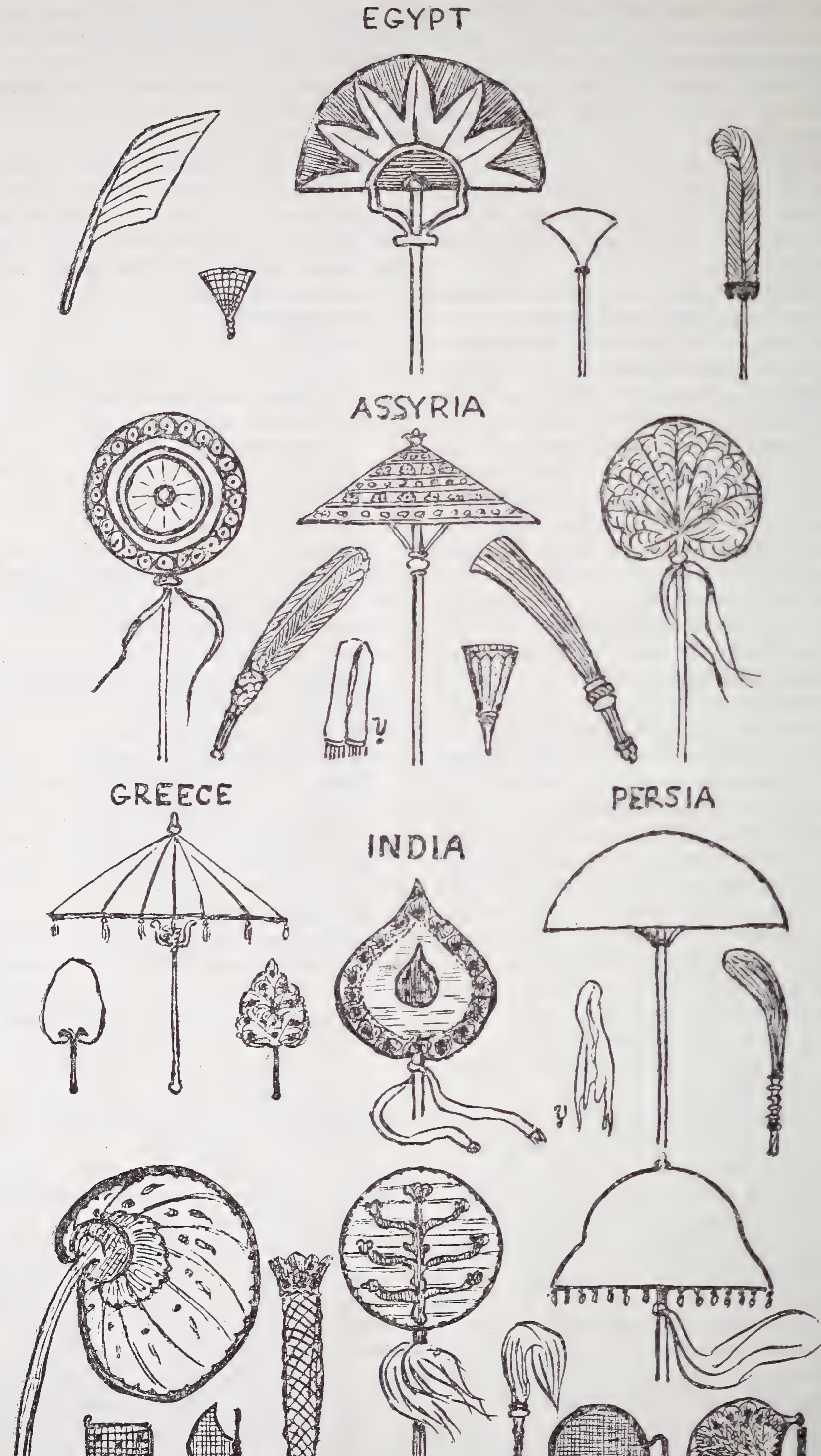
On a "marble," in the British Museum, from Kuyunjuk [near Mossul, *i.e.* Nineveh] representing Sennacherib, B.C. 681-705, enthroned before Lachish, two attendants stand behind the throne, each waving in his right hand, over the monarch's head, a *murchal* of undoubted peacock feathers, and each bearing in his left hand what I identify as the cover of the *murchal*. It is absurd to take it to be a pocket handkerchief.

On another "marble," also in the British Museum, and from the same site, representing Sennacherib in his chariot at the head of his army, he is overshadowed by a gloriously brocaded, high peaked and back-flapped umbrella, fixed by its long pole into the chariot, and an attendant on his right, beyond the driver, bears in his right hand what seems the semblance of a small hand fan.

On the largest of the rock cut reliefs of Sennacherib at Bavian, about 40 miles northward of Nineveh, two kings, or gods, are figured, face to face, the one to the left bearing in his left hand the Assyrian sceptral staff, the *chob*, still carried in India before the Viceroys, and Governours, and the Judges of the High Courts [it is just like a military bandmaster's swaggering staff] and the one to the right, in his left hand, a sceptral fan of the Egyptian semicircular type.

On another "marble," in the British Museum, from Kuyunjuk, representing Assurbanipal [Sardanapalus, of Byron, the "great and noble Asnapper," of Ezra IV. 10], B.C. 626-668, feasting his queen in a "gloriette" of trailing vines in full fruit, two attendants stand side by side, behind the king, and two behind the queen; each of the four bearing a *murchal* in his right hand; while behind the latter pair are two more attendants, one following the other; the first bearing a *murchal* or a *chauri* in his right hand, which he holds over a dish of food borne by an attendant to his left, and in his left hand the *murchal* or *chauri* cover; and the second an identical *murchal* or *chauri*, which he holds over a smaller dish of food borne in his left hand.

On a "Nineveh marble" in the Louvre, from Kuyunjuk, representing the same Assurbanipal in his chariot, a standard umbrella similar to that of Sennacherib overshadows him, and the King himself, and the attendant to the right of the driver, each holds an almost undoubtable folding fan [it may be a wine cup of the *rhyton* type] in his right hand; while the two attendants behind the chariot each



TYPES OF ANCIENT ORIENTAL AND MODERN INDIAN FANS.

waves a *murchal* of undoubted peacock feathers in his right hand.

Again, in the illustrations given by Perrot and Chipiez in their "History of Art in Chaldæa and Assyria," vol. II., 17 and 25, of the restorations of the palace of Sargon at Dar Sarkin [Khorsabad], as compiled from Felix Thomas, the standards fixed before the *harim* Court are identical in form with the semicircular fan standards of Egypt, and are here not of date palm leaves but of ostrich, or peacock feathers; while the standards before the main entrance to the palace are identical with the circular *shamsah* [compare Samson] or "sun"-standard of India. In India, as in Japan, it is often blazoned with some totemistic, symbolical, or heraldic device; and it was probably so blazoned in Assyria; for from Assyria the practice spread to Greece and Rome of using such devices on both standards and shields. Later this ritual was revived by the Saracens, and was spread over mediæval Europe by the Crusaders returning from the Holy Land.

On "The Neried Monument," of the 4th century, B.C., discovered by Sir Charles Fellows, at Xanthus, in Lycia, and now at the British Museum, representing the siege of a town by Persians, Cyrus, or his General Harpagus, is seen seated on a throne, overshadowed by an umbrella; and on a similar relief from Gjolbaschi, in Lycia, and now in the Vienna Museum, representing a fight between Greeks and Persians, the Persian king is represented on a throne holding the *chob* sceptre in his right hand, while on his left stands an attendant holding up an umbrella, the hood of which has disappeared. Close by on another throne sits the king's consort, overshadowed by an umbrella, which, like that on "the Nereid Monument," is apparently also curtained, after the fashion of the fringed or curtained state umbrellas of India; a fashion followed also at times in the manufacture of the parasols of modern Europe.

On the jambs of the back doors of "The Palace of Darius," at Persepolis, there were representations of the king, 5th century, B.C., standing, grasping the *chob* in his right hand, and holding in his left an object resembling the fan in the right hand of Assurbanipal [on the "Nineveh Marble," in the Louvre], but which here may be a wine cup of the *rhyton* type:—

> The seven-ringed cup of Shah Jamshid:
> Whereof, who knows where it lies hid.

Behind him an attendant holds over him an umbrella of the peaked Assyrian type; and another in his left hand, a *chauri*, and in his right its cover. Another Persipolitan relief represents a king seated on his throne with the *chob* grasped in his right hand, and an unmistakeable wine cup of the *rhyton* type in his left, while an attendant holds an absolutely modern Indian *chauri* in his right hand, and its cover in his left.

On the rock cut relief at Takht-i-Bostan, near Karmanshah, representing Chosroes II., or Parviz, A.D. 591-628, on horseback, the attendant by his side bears up a long-poled Indian dome-shaped standard umbrella [*chhatra*] above his head.

There are many references to the *panka*, *murchal*, *chauri*, umbrella [*chhatra*], and to standards, and the like, in the ancient literature of India, as in the great national epics, the *Mahabharata* and the *Ramayana*, the *Iliad* and the *Odyssey* of the Hindus. But the actual innumerable representations of these objects among the ruins of the Buddhistic *stupas* [this Sanskrit word, through the Prakrit *thupo*, becomes the Anglo-Indian "tope"], or relic mounds at Bharhut and Bhilsa [Sanchi tope] in Central India, and at Amravati in Southern India, and on the paintings of the Buddhistic cave temples at Ajanta in Western India, are all infinitely more valuable. The Sanchi and Bharhut sculptures, and the Ajanta cave paintings range in date from about B.C. 250 to A.D. 226, and thus coincide with the whole period of Parthian domination over Persia—following the period of Greek domination B.C. 250–331; and their immeasurable value is that they demonstrate to the most careless observer that the costumes and jewelry, the horse trappings and arms, the musical instruments, and all the paraphernalia of state, including the *samsah*, the *aflabgiri* or *saiban*, the umbrella or *chhatra* [which Sanskrit word, through the Burmese *hti*, becomes in Anglo-Indian mouths "tee," the name now given by architects to the golden umbrella, hung with tinkling bells, or its conventional reproduction in stone or plaster, which everywhere crowns a Buddhist shrine], the *murchal*, the *chauri*, and the *panka* of ancient India, were identical in form, decoration, and material with those of modern India. I will select only enough illustrations to prove this of the latter objects.

On the sculpture, on the right hand pillar of the great western *toran*, or gate, at Sanchi, representing the conveyance of Buddhistic relics from India to Ceylon, an attendant in the bow of the boat holds a garlanded modern Indian domed umbrella over the relic casket laid on the canopied deck, and another in the stern fans it with a modern Indian *chauri*. It is, moreover, in every detail, save that the umbrella and *chauri* take the place respectively of the processional fan of ostrich feathers, and the processional semi-circular fan,—it is in its general conception and features, and in every detail of design, identical with the Egyptian tablet of B.C. 1135, representing the departure of the great god Khonsu to the land of Bakhatana.

On the Ajanta cave painting representing the landing of Vijaya in Ceylon, and his subsequent coronation, his *howdaj* in the battle scene is surmounted by two garlanded and streamered modern Indian dome-shaped standard umbrellas; and right and left of him are other standards of the solar disc—*i.e.* the *shamsah*, decked out with yak tails and streamers; and yak tails are also attached to the horses heads as plumes. In the coronation scene, an attendant on either side of the king fans him with a modern Indian *chauri*. Mr. John Griffith also, in his noble work on "The Paint-

ings on the Buddhistic Cave Temples of Ajanta," Griggs, 1896, gives detailed representations of three hand fans; a square one of matted material of some sort; an oblong one, rounded at "the fly" corners, of some stiffened material; and a semi-circular one, more heavily made, and not with a handle like the two previous fans, but fashioned with a guarded indentation on the, so to say, "hoist" side, by which it is held when being used by an attendant with one or both hands. All three of these fans are to be seen in every day use in Bombay.

In Dr Waddell's "Buddhism of Thibet," 1895, page 7, in a reproduction of a Thibetan picture of the death of Gautama, the Buddha, over the nimbus about his head rises a standard umbrella bedecked with garlands and festoons of flowers, streamers, and yak tails; and on his right, a standard fan, identical with the *aftabgiri* [" suncatcher "] of modern India.

The Hindu God, Krishna, is frequently represented with a double-domed and curtained, or fringed, umbrella borne over his head, and the *shamsah* on one side of him, and an *aftabgiri* on the other. He is nearly always represented with attendants bearing the *murchal* and the *chauri*. So are Rama and Sita; and so also the great god Siva, who is sometimes attended by the god Ganapati as his *chauri* bearer.

When during the celebration of the "Most Holy," Muharram, the *aftabgiri* is set up before the house of an Indian Mussulman of the Shiah sect, it is treated, and regarded, as if a divinity. A *murchal* is placed on either side of it, and one of the original impressions of the Prophet's feet from Mount Ohud, or an imitation thereof, is set before it, and burnt incense [gum-benjamin] is waved about it, and offerings of flowers and imitation jewelry are made to it; while sweetmeats and sherbets are handed round to all the bystanders.

The fact is that from the earliest times in India and throughout Asia [including Egypt] the *shamsah*, *aftabgiri* or *saiban*, *chhatra*, *murchal*, *chauri*, and *pankas* generally, have been, like chairs, litters, standards, shields, &c., regarded as the most solemn attributes of might, dominion, majesty, and divinity. While India was under unsophisticated home rule no one could use any one of these articles except by the favour of the Sovereign, and as an ennobling mark and badge of his condescending grace. Even under the East India Company, and down to the 19th century, their junior officers were not allowed to use umbrellas; and, indeed, only Members of the Presidency Councils, and the Chaplain, and heads of Factories, while the factory system endured, and Commanders of the Company's ships, "out from England," were, and by express order, allowed to use them, or to have "roundel-boys" in their service.*

The general, and, in some examples, the specific identity of the umbrellas, fans, and fly-whisks represented on the ancient monuments of Egypt, Assyria, Persia, and Buddhistic India, with the same object still used in India being established, it become easier to surmise how the first visions of them originated. They were all at the very first suggested by the plant world. Sir Thomas Brown, in the *Garden of Cyrus*, names the mediæval elder tree "the White Umbrella"; and Barham, in the *Ingoldsby Legends*, writes:—

> "The tempest blew and the straggling yew,
> His leafy umbrella was wet through and through."

These are flashes of literary fancy. They recall Lord Rosebery's speaking, in 1885, of Mr. Gladstone's political programme as "his umbrella." But it must have been an instinctive act which led men in primeval times to use the branches of trees, and any large leaf, as a protection against the rays of the sun. We know that the original "aspergillum" [so called by ecclesiastical writers] of the Roman augurs was a branch of the laurel [bay] tree. Later the use made by the buffalo, the horse, and the *chamara*, of their own tails, would naturally suggest to man the use of them as dispersers of flies. The fly-flapper, as discriminated from the fly-whisk, was not suggested probably until after the invention of the standard, processional and hand fan. As for the fan specifically, any broad leaf, as of the water lilies, the palms, and the plantains, would have suggested it; or any piece of matting taken up and crumpled at one of its angles into a rude handle; and the "vannus" of the Romans, and its counter-part among the Egyptians, and the *sup* of the Hindus, as well as the square, matted fan of India, must have originated in this way. The date palm suggested to the ancient Egyptians the form of their original semicircular standard, and processional fan [the conventionalised profile of the date palm head]; and of their original falculate fan [the natural profile of a single date frond, with its pinnæ interlaced]. Their third form was that of the papyrus head, in conventionalised profile. In Ceylon and Southern India the fan was suggested at once, in its typical and perfected form, by the leaf of the *Corypha umbraculifera*, the "Umbrella Palm;" in India, also by the similar but smaller leaved *Borassus flabelliformis*, the "Fan-palm"; in China and Japan by the similar and yet smaller leaved *Chamærops fortunei*; which is represented in Baluchistan and Afghanistan by *C. ritchiana*, and, sparsely, along the Mediterranean coasts by *C. humilis*: all three being so-called "Fan-palms." The last seems to have made no suggestion to any of the people of the Mediterranean basin; and therefore they imitated the date tree, and papyrus, and derived ostrich feather fan forms received from Egypt; and the peacock tail forms [*chauri* and *aftabgiri*] received through Persia and Assyria from India. The folding Japanese [and subsequently Chinese) fan is derived from the sprouting palm leaf. The Indian double-handled circular fan—already referred to by me and described by Miss Falcke—is an elaboration of the lotus leaf, which is probably the original also of all the flat circular fans of India, China, and Japan.

* Jonas Hanway was the first habitually to use the umbrella in the streets of London—about 1778.

as all forms of the fan, including the *aftabgiri*, are, in India, called *panka*, the unavoidable inference is that the aboriginal fan of northern India, *i.e.* Hindustan, was that suggested by the proud and resplendent feathers of the peacock. The original Indian fly-whisk, which was also the *murchal*, literally the "peacock-tail"; while the *chamara* or yak tail, commonly called *chauri*, possibly came into India from Thibet with ultramontane Buddhism. As the Buddhistic standard and processional fan, which now bears the Persian name of *aftabgiri*, was made in India of peacock feathers, after the manner of the similar Egyptian fan of ostrich feathers, it may be safely assumed that all the Chinese "heart" or "cone-shaped" feather fans originated in the Buddhistic *aftabgiri*.

The honour, sanctity, and worship in which these objects are held in India is readily understood by those who have intimately lived among the Hindus on their native soil. Like all people who pass their lives in close and continuous communion with nature they have a quick ear for natural sounds, and attach the highest significance to them; such as the rustling of leaves, the sharp whistling of the bamboos as in their rapid growth the young stems sway against and affrict each other, the rattle of ripe pods as they suddenly burst on the noontide silence and scatter their seeds far and wide, the murmur of flowing waters, the soughing of the boding wind and low trailing clouds, and the musical prattle of casually falling rain. All similar artificial sounds, such as those produced by the winnowing of grain, the waving of a fan, the crackling of a fire, the boiling of water, the shaking of a rattle, the tinkling and ringing of bells, and the swift rushing hiss of the grinding steel of a railway engine steaming through the umbrageous depths of the primeval forest, are, therefore, also significant. These and the like natural sounds are the voices of the earth calling, in every mood of sympathetic joy or sorrow, to mankind, and the artificial ones, the responsive echoes through which men bring themselves into literally ineffable communion with the Great God Pan [Deus Arcadiæ] and the Good Goddess the Great Earth Mother, [Idæa Mater].* We of the West in the vain pride of intellectual superiority are apt to forget that men also are simply whisks of the common elements, susceptible of every elemental impression. But the Hindus who have uninterruptedly maintained and transmitted from father to son the illuminating traditions gathered in antiquity at the first divine beginnings of things, intuitively recognise the all embracing, all controlling affinities which throughout the infinite universe bind the seen and unseen, the material and spiritual, the emotional and rational, in one stupendous, indivisible whole, and are subtly sensitive, and frankly and freely responsive, to every real, or fanciful, intimation of their essential concordance, and all hallowing unity.* It is this which explains the pipe, the drum, the rattle, the cymbals, the bell, the "bones" in the worship of Cybele, and the sistrum in the corresponding worship of Isis, and Corybantic worship generally; and the mystery and the sanctity attending the use of the winnowing fan in ancient Italy and modern India; and why the *panka* in all its variants is regarded in India as an august and divine symbol, and not, as in ancient Greece and Italy, as an article of mere furniture, and, in modern Europe, a superfluity of feminine frippery. Plutarch [*Concerning Isis and Osiris*] tells us of the sistrum—that its concave upperpart represents the concavity of the heavens, and its intrusive handle the force of generation pervading Nature, and the four shrilling rods, which pass transversely through its arc, the four elements of earth, water, the air, and fire, by the ceaseless vibration of which all things animate live, and move, and have their being. If the vibrations cease, they die; but by the shaking of the sistrum Typhon,—the Master Microbe, Bacillus, or Bacterium,—is expelled and paralysed.

There is, therefore, more in a fan than is dreamt of in Johnson's matter-of-fact definition:—"An instrument used by ladies to move the air, and cool themselves;" or in Addison's prettier one:—"A little modish machine." A Frenchman, with finer intuition, has defined it:—"The sceptre of woman." The women of modern Europe, all through the 18th century, made it a veritable sceptre of rule in their hands; and a sistrum with which they thrilled all the gallantry of that Augustan age; and a winnowing fan with which they gathered the best of the men into

* See Ausonius, Epist: XXV., "Respondent et saxa homini. percussus ab antris Sermo redit."—to "Isiacos agitant Mœreotica sistra tumultus." And compare Henry More's "Song of Bathynous," noting the lines:—

> "Music that the heart of Jove,
> Moves to joy and sportful love:"

where "Jove" is a contraction for "Jehovah." Compare also George Withers:—

> "Come O come! in joyful lays
> Sound we God Almighty's praise."

> "Ad fermandum cor sincerum
> Sola fides sufficit.
> * * * *
> Et antiquum documentum
> Nova cedat ritui."

* The whole Cosmos is for the Hindu an illuminated MS. of spiritual symbols and divine parables. In such books of private devotion as the *Sri-mad Bhagavatam*, every phenomenon of nature, from space and eternal matter, to blood corpuscles, fern spores, and microscopic crystals. is cited in its natural series and systematic order, and its "heavenly truth," *i.e.* its religious application, enforced. I will quote, from memory, one brief example of the form and spirit of this method of education in personal piety:—

G.—The Lessons of the four components of this world:—

1. O Earth, that we should live for others and not for ourselves, in all this our fleeting, transitory life.
2. O Waters of the Earth, that we should keep our souls transparent, and sweet, and pure in their course through this our fleeting, transitory life.
3. O Air and Winds, that while all pervading in our service of others, we should not attach ourselves too much to any object in this our fleeting, transitory life.
4. O Fire, that the ardour of our love for God should burn ever higher and higher, until absorbed into His all purifying Love, in which alone is our abiding and eternal life.

their own goodly fellowship, and cast out the chaff to the four winds. The fan may, therefore, be said, in a whimsical way, to retain in modern Europe—what it never attained in ancient Greece and Italy—something of its pristine spiritual prepotencies.

But on this point he would not enlarge. Miss Falcke has treated of the history of the fan in modern Europe with comprehensive fulness and detailed accuracy; with the certitude also which comes only of slow and surely acquired professional knowledge; and the enthusiasm of a woman who knows her art as well as trade. He had the greatest pleasure in moving the vote of thanks which all present would recognise as Miss Falcke's well earned guerdon.

CATALOGUE OF FANS.

The following is a Catalogue of the Collection of Fans exhibited in the Society's Library, from Wednesday, March 18, to Wednesday, March 25, 1903:—

CASE 1-12.—TWELVE GLASS FRAMES, CONTAINING 26 FANS. *Lent from the Victoria and Albert Museum, by the Board of Education, South Kensington.*

Horn frame; the mount tiffany, painted with figures and spangled. French: early 19th century.

Ivory frame; painted with a dancing party, &c., Chinese groups and miniature portraits. "Vernis Martin" decoration. French: early 18th century.

Ivory frame, &c.; painted with a festival of the gods; and Chinese ornament. "Vernis Martin" decoration. French: early 18th century.

Ivory frame; silk mount; painted emblems; in the centre "Penelope" printed in colours. English (?) About 1750.

Ivory, pierced; gilt and painted, the subjects probably by Angelica Kaufmann. English: late 18th or early 19th century.

Ivory frame, painted vellum mount. English: about 1760.

Ivory frame, carved and pierced; painted vellum mount. English: about 1760.

Ivory frame, carved and pierced; vellum mount, painted with three "Christian Graces." English: about 1770.

Ivory frame, carved and painted in imitation of Chinese: vellum mount, painted in black. English: about 1750.

Ivory frame, carved and pierced; painted paper mount. French: about 1760.

Ivory frame, carved and painted and tinselled; painted paper mount. French: about 1760.

Ivory frame, perforated; cambric embroidered mount. French: 19th century.

Ivory frame, carved and pierced; the mount of chicken skin. Italian or French: early 19th century.

Wood; painted and engraved with roses and medallions. German (?): 19th century.

Ivory frame; vellum mount; pen and ink sketches. Swiss: 19th century.

Ivory, carved and pierced; vellum mount painted with "Sale of Joseph by his Brethren." German: about 1760.

Ivory frame; carved, pierced, and embossed with gold; paper mount, painted with landscapes. German: about 1750.

Horn frame; silk mount, with inserted band of gauze. Dutch or English: 18th century.

Sandalwood; pierced, and partly painted with forget-me-nots. Dutch (?): 18th century.

Ivory; pierced, and painted with a basket of flowers, &c. Dutch: 18th century.

Ivory, pierced; painted in Japanese style. Dutch: 18th century.

Ivory, painted with figures and dragons in Japanese style. Dutch: 18th century.

Tortoiseshell, pierced and embossed with gold, the mount embroidered with landscape, &c. Flemish: about 1650.

Ivory frame, carved; mount of chicken skin, painted with "Rinaldo in the Garden of Armida." Flemish: about 1700.

Ivory, carved; vellum mount, painted with "Bacchus and Ariadne." French: 17th century.

Mother-o'-pearl frame, incised ornament with gold foil inlaid; the mount of chicken skin, painted with view of St. Peter's, &c., Rome, and with panels and bands of Renaissance ornament. Italian: early 19th century.

CASES 13-14.—*Lent by the Marchioness of Bristol.*

Battoir fan. Leaf painted on paper in medallions, silvered in parts. Ivory sticks, carved and gilt, with the arms and emblems of France and Spain introduced. (Probably a marriage fan.)

Leaf painted in silk, Watteau subject, with borders embroidered in gold thread, ornamented with paillettes. Tortoiseshell sticks, carved and gilt.

Cabriolet fan. Leaves painted on paper, Ivory sticks, carved and painted.

French fan.—Leaf chicken skin. Painting of "Hector and Andromache," from a picture by Cl. Coypel. Ivory carved sticks. Outer sticks elaborately ornamented with plaques of agate, and set with white and coloured paste jewels, watch set in handle.

CASE 15.—*Lent by Mrs. Bischoffsheim.*

French fan, elaborate painting on both sides, mother-of-pearl sticks, Louis XIV. period.

French fan, painting on both sides, carved ivory sticks, classical subject on one side, eastern on the other.

CASE 16.—*Lent by Mrs. Rodwell.*

River scene, painted on chicken skin; with carved ivory sticks.

CASE 17.—*Lent by Miss Lizzie Oldroyd.*

Maltese lace fan, with mother-of-pearl sticks.

Lace fan.

Chinese silver gilt fan, enamelled.

CASE 18.—*Lent by Messrs. Marshall and Snelgrove, Oxford-street.*

Honiton lace fan, with painted pastoral design; entirely English production.

CASE 19.—*Lent by Mr. Samuel Chick, Newman-street.*

Brussels point de gaze fan; cover, needle made. Design: treatment of roses and tulips, lilac flowers, broken by a running riband with star and circle, needle fillings.

CASES 20-21.—*Lent by Miss Falcke, Orchard-street, Portman-square.*

Two Italian fans, date about 1730.

Two French fans, period of Louis XIV. Oriental decoration on sticks.

French fan, period Louis XIV. Painted on chicken skin.

Two French fans, Louis XV. period.

French fan, Louis XV. period, carved ivory case and pearl appliqué.

French fan, Louis XVI. period, fan painted on silk.

Five French fans of the Empire period.

Two French fans, Empire period, "brisé."

Two Spanish fans.

Old top of lace with Chinese carved sticks.

Old Indian carved fan.

Old English stained ivory and piqué sticks, painted chicken skin.

English fan, Empire period.

CASE 21.—*Lent by Miss Oldroyd.*

Child's fan, coloured engraving on paper.

CASE 22.—*Lent by Mr. Samuel Chick.*

Elaborately carved Chinese ivory fan.

CASE 22.

Carved and pierced ivory fans, lent by Miss Webster, Mrs. Oldroyd, and Mr. Redston.

Horn fan, perforated, with painted ornaments.

CASE 23.—*Lent by Miss Webster.*

Painted paper fan.

CASE 23.—*Lent by Miss Colston.*

English fan, with coloured Bartolozzi engraving.

CASE 24.—*Lent by Mrs. Cantlie.*

Fan, borne at court in Japan by the Daimios.

Early Korean fan.

CASE 24.—*Lent by Mrs. Oakley Coles.*

Silk fan, with silver spangles, carved and pierced ivory sticks.

CASE 25.—*Lent by Miss Colston.*

Frame, containing five fans, as follows:—

Spanish fan, with painted scene; period 1830.

Old Spanish fan, representing the introduction of the Duke of Buckingham to the Infanta of Spain, when asking her hand for Charles, Prince of Wales (afterwards Charles I.).

French fan, painted on chicken skin; carved ivory sticks.

English fan, with coloured Bartolozzi engraving, mounted on stick made of tortoiseshell and ivory, alternately.

French fan, with painted pastoral scene; formerly in the possession of Miss Helen Faucit (afterwards Lady Martin).

MODERN FANS.

CASE 26.—*Lent by Madame Marcot, 18, Newman-street, W.*

Painted on gauze with figure representing dragon fly, by F. Houghton; lace edge in point gauze lace, dragon flies. Pearl stick with gilt decorations.

Painting on gauze, by F. Houghton; subject, "Bergers," after Boucher. Pearl stick, gilt decoration.

Painting on gauze, by F. Houghton; floating figure and cupids, point lace border. Pearl stick.

Painting on gauze, by F. Houghton; figure reclining on rocky shore; point lace border. Pearl stick.

Painting on skin, by F. Houghton, "Les Baigneuses." Pearl stick.

Point lace fan, with medallions inserted, painted by F. Houghton; "Genre Watteau." Carved pearl stick.

Black gauze, painted by F. Houghton; "La Source." Tortoiseshell stick.

Painting on skin; floating figure by Michaels. Smoked pearl and gilt stick.

One red pearl and gilt stick; medallions, with spangles and paintings; style, Louis XVI., by F. Houghton.

One pearl and gilt fan; style, "l'Art Nouveau," painted by Baguez.

One pearl and enamel fan; "l'Art Nouveau" (sleep) Baguez.

CASES 27-28.—*Lent by Messrs. Liberty and Co., Regent-street.*

Types of hand-made lace, mother-of-pearl and tortoiseshell sticks.

Types of hand-painting and spangling, carved, inlaid and painted sticks.

Types of painting and spangling on silk gauze, mounted in carved and inlaid bone sticks.

Ostrich feather fans.

Plumage fans (Red Argus) mounted on shell stick.

CASE 29.—*Lent by Messrs. Marshall and Snelgrove, Oxford-street.*

Hand-painted on skin, carved pearl, and inlaid shell mounts.

Hand-painted on silk, carved pearl mount.

Honiton lace, painted medallion tortoiseshell mount.

Lace, point de gaze, carved pearl mount.

Lace, lacet point, inlaid pearl mount.

Copies of antique empire, pearl and carved horn and bone sticks.

Copy of antique, fancy bone mount.

Floral French painted, new shape.

CASES 30-31.—*Lent by Messrs. Debenham and Freebody, Wigmore-street.*

Six fans, painted, lace, and feathers.

CASE 32.—*Lent by Mr. R. G. Pughe.*

Painting in tempera on vellum (18th century). Subject, "The Old Pretender with his Wife," painted for fan.

CASE 32.—*Lent by Mr. John Leighton, F.S.A.*

Spanish fan, sold in the Bull Ring at St. Sebastian, with painting of bull fight.

Modern paper Japanese fan.

BOOKS.

Lent by Mr. Montague Guest.

Fans and Fan Leaves collected and described by Lady Charlotte Schreiber; English and foreign. 2 vols., folio. 1888.

Lent by Mr. J. Ettlinger.

Badischer Kunstgewerbe-Verein. Alte und Neue Fächer aus der Wettbewerburg und Ausstellung zu Karlsruhe, 1891. Folio.

Photograph of the Fan presented to Her Majesty the Queen for use on Coronation day, 1902, by the Worshipful Company of Fan Makers.

MEETINGS FOR THE ENSUING WEEK.

WEDNESDAY, APRIL 15...Royal Meteorological Society, at the Institution of Civil Engineers, Great George-street, Westminster, S.W., 7½ p.m. 1. Mr. Frederick J. Brodie, "The Prevalence of Gales on the Coast of the British Islands, 1871-1900." 2. Mr. Joseph Baxendell, "The Duration of Rainfall."

Royal Microscopical Society, 20, Hanover-square, W., 8 p.m. Mr. E. B. Stringer, "A new method of using the Electric Arc in Photomicrography." There will also be an Exhibition by Mr. C. F. Rousselet of mounted Rotifers of the genus Brachionus, at 7½ p.m.

THURSDAY, APRIL 16...Linnean, Burlington-house, W., 8 p.m. 1. Dr. H. Charlton Bastian, "Some points in connection with the ordinary development of *Vaucheria* resting spores." 2. Mr. W. Wesché, "The Labial and Maxillary palpi in Diptera." 3. Prof. G. S. West, "Freshwater Rhizopods and their Classification."

Royal Historical, Clifford's-inn, Fleet-street, E.C., 5 p.m. Mr. E. A. Lewis, "Development of Industry and Commerce in Wales before the Act of Union."

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FRIDAY, APRIL 17, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Wednesday, April 22, 8 p.m. (Ordinary Meeting.) Walter Francis Reid, F.C.S., "Modern Bee-Keeping."

Thursday, April 23, 4.30 p.m. (Indian Section.) Herbert Mills Birdwood, M.A., LL.D., C.S.I., "The Province of Sind."

Further details of the Society's meetings will be found at the end of this number.

APPLIED ART SECTION.

Messrs. James Powell and Sons have kindly invited the Applied Art Section to visit the Whitefriars Glass Works, Tudor-street, E.C., on Tuesday evening, April 28th, from 7.30 to 10.30 p.m. A short paper, "On Modern Table Glass," will be read by Mr. Harry Powell, and the processes will be explained in the glass-house.

The accommodation is strictly limited and 100 tickets only will be issued. These tickets will be issued in order of application to Members until the number is exhausted. Each Member is entitled to apply for one ticket, which will be transferable.

No one can be admitted without a ticket.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

COLONIAL SECTION.

Tuesday afternoon, March 31, 1903; The Right Hon. Sir George Taubman Goldie, K.C.M.G., in the chair.

The paper read was—

THE STATE OF NORTH BORNEO.

By Henry Walker,

Commissioner of Lands, British North Borneo.

The subject of my paper is the British colony officially known as the State of North Borneo; and with the lantern I shall be able to give some illustrations of the country and the people we rule.

It is interesting to note that the charter granted to the British North Borneo Company in 1881 was the first charter granted by the English Crown since the formation of the Hudson Bay Company or the East India Company some 300 years ago, and it was the forerunner of the charters granted to the Royal Niger Company, and the South African Companies, which have lately been so prominently brought to our notice by the South African War.

I am glad to see here to-night some of the gentlemen who took a prominent share in the acquisition of our territory from the Sultans of Brunei and of Sooloo, and in the formation of the British North Borneo Company, including Mr. R. B. Martin, M.P., the Chairman of the Chartered Company, and Mr. Dent, who have been connected with the company from its commencement, and Mr. W. C. Cowie, our managing director, who when Baron Overbeck was negotiating the concession of the territory was able, owing to his great influence with the native princes, to materially assist that gentleman. My own connection with North Borneo began a little over twenty years ago. I landed at Kudal in January, 1883, and one of the first men I met was Mr. Cowie, who long before and since has done so much to promote the advance of North Borneo.

I do not propose to weary you with many figures, but I may mention that the trade returns prove a very considerable advance in civilisation and in the wealth of our colony since the formation of the chartered company. A paper on Borneo was read in 1884, in this room, by the late Mr. Francis Cobb, who quoted the

value of the exports and imports for the east coast of North Borneo during the second half of 1882 as being 192,000 dols. Of late years this value has frequently been cleared at Sandakan and Kudat, not in one year, but in one day; and last year the trade of North Borneo was estimated at over seven million dollars. Our revenue is also growing. Mr. Cobb in 1884 quoted the revenue at 82,000 dols.; last year's estimate was 820,000 dols, and we see reason to expect that the revenue will also be expressed in millions before many years have passed.

Undoubtedly the first step to this end is to supply our present population with profitable employment. The next is to increase the population by attracting settlers from the adjacent countries, and these matters are receiving careful attention.

Our population numbers about 175,000, for the most part Malays. We attempted a census in 1901, but it failed to reach the interior tribes, and is unreliable. Of the Chinese we have more reliable data—they number about 13,000. There are a few hundred Philippinos, and Japanese, and Indians. The number of Europeans is about 250.

The Malays are by no means of one class, or speak one language, but they all have one characteristic: they are an intelligent race, and are capable of rising to a high scale when educated. Some of the coast natives can read and write in Arabic characters, and they easily acquire a knowledge of Roman characters. The Mohammedan priests have a court, where the social relations of the natives, marriage, divorce, &c., are guarded. We have established native legal courts, presided over by three headmen, under the eye of the Resident, and we have the satisfaction of knowing that the natives under our rule are becoming a law-abiding people. We have had troubles with them, chiefly in the remoter districts, but the residence in the interior of English officers, and the better communication now being established, will prevent any recurrence of a serious nature.

Our Malays are divided into three distinct classes—Bajous, or seafarers; Dusuns, or farmers; Muruts, or hunters of the interior. The Bajous were well known as pirates in the old sailing-boat days, but the advent of steamers in Malay waters made piracy impossible. Sir Harry Keppel, who was one of our directors for many years, had a famous fight, sixty years ago, with Malay pirates in Marudu Bay, on a river where the New London Borneo Tobacco Company now have some large tobacco estates; and I have frequently talked with Malays who in their young days made a business of piracy. Two of these native headmen became headmen under our rule and have rendered us very able assistance.

When I arrived in Borneo in 1883 the Bajous got their living by fishing and collecting sea produce, such as *bêche-de-mer* and tortoiseshell, and they chiefly lived in boats, but they now find more profitable employment, and many of them are building houses and planting cocoanuts, and at Sandakan they are rendering valuable assistance in collecting mangrove bark for the mangrove extract mills, and in cutting firewood for export to China, where it commands a good price. In fact, the Bajou, under our rule, is settling down into a good workman, and is building up a permanent home, in place of leading the roving, piratical life he was formerly accustomed to. In appearance the Bajou is small, active, dark-coloured, with very bright, gipsy-like eyes, and straight black hair. They are better looking than the Dusuns, or agricultural class, who accuse them, and very justly, of stealing their buffaloes and cattle. The Bajous at the northern end of our territory have a lot of ponies, which they ride fearlessly, spearing the great sambur deer while at full gallop. The ponies used for this purpose are named after the number of kills achieved with their assistance, and a brother officer told me of a hunt of this kind where one of the ponies engaged already had fifty-two kills to his credit.

The Dusuns are the farmers of North Borneo. They probably number 50,000. The sago forests on the Padas River are owned by the Dusuns, and, farther to the north, the Dusuns cultivate padi, and use ploughs. They also own a large number of cattle and buffaloes. Both the Bajous and the Dusuns must have been much more numerous in the year 1762, when Mr. Dalrymple, the East India Company's Agent, made a report on the territory we now know as North Borneo. In those days the exports of pepper from that portion of our west coast, where we have lately made a railway, were so large that, with a view to buying the pepper crop from the Dusuns, the East India Company established a trading station on the island of Balambangan, which lies at the north end of our territory. Mr. Dalrymple then estimated the population around Marudu Bay alone at 150,000, or about ten times what it is to-day,

nd a Mr. Hunt stated that the population ear Kimanis, in 1812, was 35,000, when to-ay we can only number 8,000. One reason ›r this decrease in the population may be ›und in the constant attacks from the pirates, ho, in their turn, were partly exterminated y Sir Harry Keppel in 1843. Intertribal ars and epidemics also reduced their num-ers. When I first went to Kudat in 1883 became acquainted with a headman who as the sole living representative of a llage that a few months before had con-ıined sixty people; the others had died om small-pox. This will afford some idea of ıe fearful effect of the disease among the ıtives. Since 1883 we have had very little nall-pox in North Borneo, which I attribute › vaccination and to the medical assistance ·ovided by the chartered company. The cost ' our medical staff and stations is about fifty ıousand dollars a year, very little of which is covered from the public; but it is a wise :penditure, and it undoubtedly assists in the ·velopment of the country. At all our stations ere are dispensaries with qualified Eurasian sistants, and at the four more important ıtions there are properly qualified doctors. 'e have quarantine stations at the principal ›rts. Leprosy is controlled. The Chinese ıd Malay lepers are collected on an island in .ndakan Bay. I had occasion to visit them January of last year with the Governor, Mr. rch, and we found them very comfortably ttled.

I referred just now to the pepper crop raised ' the Dusuns in 1792, and I may mention at the pepper gardens were allowed to go t of cultivation owing to the extraordinary actions of the Sultan of Brunei and his icers. It was the custom of the Sultan to quire a share of garden produce from all his bjects. The Sultan entrusted the collection his princes, each of whom visited a special strict and collected the Sultan's share of the ›ps, but at the same time the collector took vantage of his position to squeeze the naining, and sometimes more than remain-;, profits out of the natives, who finally andoned the cultivation of any product for port, and confined their efforts to raising ›d for their daily wants.

The action of the Sultan and his headmen ıded to prevent any systematic labour by : natives. Under our rule the natives : working more systematically, and are ıking more money. When we took charge North Borneo, in 1881, the total value of exports was 145,000 dols., and on referring to the list of articles exported I find they consisted almost entirely of jungle and sea products collected by the natives. In 1901, twenty years later, the exports of jungle and sea products had increased by 500,000 dollars, and this increase has been effected in spite of the large number of natives who have abandoned the casual collection of jungle or sea produce, and have taken to steady employment afforded by the new industries which are beginning to flourish under the protection of the chartered company. I may here mention that the total value of our exports in 1901 was twenty-three times the value exported in 1881, the first year of our charter. Not only do the exports prove that the natives under our rule are earning more money, the imports also tend to prove the same. Our imports in 1901 were thirteen times the value imported in 1881, when they amounted to about a quarter million dollars. Our list of imported articles does not differentiate very minutely, and I am, therefore, unable to tell you many details, but I note that the Malay begins to add to the revenue at a very early age. He is brought up on the imported bottle, which is filled with imported Swiss milk. Those of you who see our newspaper, the *North Borneo Herald*, may have noted that the most prominent advertisement is the milkmaid brand of Swiss milk. Before the youngster has begun to walk he has acquired a desire to smoke his mother's cigarette, filled with Wills's best Bristol birdseye. Later on he dissipates his earnings in Rimmel's most exquisite scents, and this luxury is indulged in by both sexes.

But that is not quite the limit of their desires. On one occasion I visited Brunei, the ancient capital of Borneo, which is absolutely a Malay town, and I noted in the chief Malay shop the following articles:—Austrian bentwood chairs, large mirrors, enamelled luncheon sets, kerosene stoves, English tinned meats and biscuits, and a very superior lot of glass, crockery, and soft goods. Our shops in the towns of North Borneo contain similar goods. Of course, all these good things have to be paid for. From a Malay point of view, the easiest way to obtain money is to make a contract to do work on condition of a sum of money paid down—called the advance system. It is a bad system, which has to be reckoned with when employing Malays, and also, generally, when employing Chinese. Large numbers of Malays are employed by the timber com-

panies, by the mangrove extract works, and by the tobacco companies, and a great deal of the wages earned in North Borneo is paid to the Malays, who, as I have explained, spend their money with quite a gentlemanly freedom; but, I am pleased to record, a few have expended some of their money in making cocoanut plantations, and were incited to do so by the offer of land on easy terms.

I am glad to refer to the comforts and luxuries indulged in by the Malays, because it affords some idea of the contribution made by the natives to the revenue. I have made the calculation, and it works out at ten per cent. of their earnings—that is, I think, the minimum contribution of the natives to the revenue. This tends to show that the more employment we find for the native, and the more profitable we render that employment, the more will our revenue improve. I may mention that our Governor intends to re-introduce pepper and gambier planting again into North Borneo, and to that end is distributing plants among the natives and the Chinese gardeners.

Religion.—With regard to religion, the natives of Borneo may generally be described as Mohammedans, but of no severe practice. A very curious religious phrensy called *Malingcote*, has, I am told, occurred in Borneo from time to time—not near the coast, but among the less enlightened natives of the interior. It was repeated in the year 1891, when a native of the Sipulote country, in the interior of North Borneo, had a dream during a severe illness, that, provided certain ceremonies were observed, angels would descend and bestow wings upon their worshippers, with which they could fly to heaven.

The first prophet was a man named Tahang; others soon appeared, and the phrensy rapidly spread. The ceremonies appear to have chiefly consisted of feastings and making presents to the prophets, who did not scruple to threaten the villages with thunderbolts from heaven, which would kill the people, and hurricanes, which would destroy their houses, if *Malingcote* were not observed. During *Malingcote*, all fowls, cattle, pigs, and even dogs, were to be sacrificed and eaten or destroyed; the padi crops were cut and the grained turned into intoxicating liquor, and as long as the food and drink lasted the natives gave themselves up to the phrensy—expecting their wings to grow when they would fly to the sky and live on the padi there. With regard to the sky padi, the prophets asserted that it took only ten days to grow, and if cut to-day it would yield again to-morrow. The people were so eager to become angels that one man, probably under the influence of liquor, climbed cocoanut tree and threw himself down, expecting the promised wings would transport him to the sky, but he only broke a leg. Another man gave his wife to one of the prophets on the promise that his wings would grow in seven days. One of the consequences of observing the ceremonials enjoined by the prophets was that the human body would be invulnerable and after a feast a native, to prove his invulnerability, cut his own leg so badly as to sever a sinew and was lamed for life. I am glad to record the fact that one of the prophets came within the grasp of a West coast magistrate, who gave him two years. That was in 1891-92. In the latter year I went through the country where the prophets had been at work. The natives had at the time of my visit resumed their ordinary vocations, and treated the *Malingcote* rather in the light of a joke. The special object of my visit in 1892 was to report on the best route for a road to the interior, the making of which would introduce the benefits of civilization, and would prevent the repetition of such scenes as I have just described. And in 1895 I made a footpath 33 miles long through the Penotal gorge, to the back of the coast-range. The natives assisted me and I paid them in cloth, fathom of red or black cloth to each man, woman, or child, at the end of each day's work. When they had stored up more cloth than they could use they requested money, and I paid their wages in bronze cents, one hundred to the dollar, and later they took their pay monthly in dollar notes, with which they bought goods at the shops established by traders, who gladly took advantage of the new road to push their trade into the interior. When I first visited the interior the price of rattan was one dollar a picul, paid for in goods, and the trader after transporting the rattan to Labuan received 7 dols. An enormous difference, but the cost of the transport of the rattan was so great that the trader only obtained a fair profit. The trader paid no money—money was unknown in the interior up to 1895, and trade was carried on by barter. To-day well supplied shops are well supported by the natives at Fort Birch and also at Kaningow.

Anyone who has seen the estimates of revenue of North Borneo would gather that the largest revenue is derived from the east coast, where we have bestowed the greatest

care and attention, and the smallest revenue is derived from the west coast, where it may be frankly stated we have bestowed very little attention until lately. The census taken in 1901 enumerates a population of 52,000 souls on the east coast, including Kudat, who, according to the revenue receipts, pay 12 dols. per head; and on the west coast and interior, the enumerated population was 52,000 souls, paying three dollars per head. Undoubtedly the largest unenumerated population is on the west coast and in the interior.

It would seem that the best way to increase our revenue is by supplying profitable employment for the native population of the west coast and of the interior, as well as by introducing more Chinese, and by improving the means of transport from the interior. These points have been occupying the attention of the company since 1895, and a railway has been made, and is being continued to the interior, in all, a distance of 110 miles, and lately, the Governor has asked for 16 miles of rail to enable him to make two small branch lines. Railways without roads would be imperfect, and during the past year several bridle paths have been made in connection with the railway and others have been traced, which will enable us to come into touch with the natives in the interior. English people have no conception what it means to be without roads. To you the roads from your houses appear as essential to your life as the air you breathe, and you can hardly conceive existence in a country unprovided with roads. I have lately been much interested in reading about a trip made by our Governor last July, with four of his officers, into the interior. The party were able to ride in some places, and in others the walking was so easy over the new paths, that I note they travelled from Kaningow to Fort Birch (25 miles) in one day, and from Fort Birch to Beaufort (35 miles) in one day. I happened, in 1892, to travel over the same ground with two of the officers, and we took eight days. When the path from Kaningow to Fort Birch is finished, and the railway to Fort Birch is completed, which Mr. West, the company's railway engineer, estimates will take another twelve months, the traveller will be able to ride from Kaningow to Fort Birch, and rail it through Beaufort to Jesselton in one day. It is difficult to explain what a difference this comparatively rapid communication will make in our relation with the natives or in the transport of produce and merchandise, and also in the revenue, but it will undoubtedly very greatly benefit them all. The natives already find they can get a higher price for jungle produce.

The railway from Jesselton to the interior passes through valuable timber forests. The cutting down and transport of the timber will afford a congenial employment to the Malays. The natives of the far interior will be able to get the heavier jungle produce transported to the coast by the railway, which will also transport the sago owned by the natives, and the tapioca lately planted by Chinese along the line. Incited thereto by the making of the railway, a tobacco estate is now being opened near Fort Birch, in the interior, And should the estate prove a success, there is a large area of flat land available for tobacco planting. All these employments require Chinese and Malay labour, and instead of being the neglected side of the country the west coast promises to be in a very prosperous condition before long.

Telegraph.—Another matter that has received attention is telegraphic communication. We have about 500 miles of telegraph line erected by the chartered company, extending from Labuan across the territory to Sandakan, and to Darvel Bay; and along the west coast to Jesselton and Kudat, and from all these points we can communicate with London and the world through the English cable at Labuan.

This means great progress. Up to the last few years, our timber merchants were sorely handicapped by the want of telegraphic communication. They could cut timber, but they could not readily arrange a sale, or engage vessels to carry the timber when sold. To-day, the telegraph line is largely used by our timber merchants, who are in daily communication with China and with Manila and Singapore, and we hope soon to hear of shipments of timber to other places. One branch of our timber trade is shipbuilding. Manila has been a good market for barges and steam launches built by European firms at Sandakan, and the Chinese have established there and at Kudat a boat-building trade, which is on the increase.

I need hardly dilate on the advantage it is to the planting and trading companies in North Borneo, to be able to use the telegraph line, but I should like to say a few words on the benefits conferred on Labuan, and the coal trade of Labuan and Borneo, by the English cable laid to Labuan.

Labuan is a Crown colony administered by

the chartered company. It possesses a good harbour and a valuable coalfield. Neither of these have, however, been of much avail until the establishment of a telegraphic station on Labuan by the Eastern Extension Telegraph Company.

The administration of Labuan was entrusted by the English Crown to the chartered company, in 1890. The revenue in that year was 20,000 dols., last year it was 60,000 dols. This increase is entirely due to the increase in trade brought about by the policy of the chartered company, in offering a suitable site and buildings to the Telegraph Company, provided they would lay a cable *viâ* Labuan, between Singapore and Hong-kong.

The cable was laid in 1894, and North Borneo immediately became a place of great strategic importance, and has since been periodically visited by English men-of-war. The telegraphic communication thus established with the world has enabled the coal companies of Labuan and Borneo to arrange to supply bunker coal to passing steamers, and I see by the *North Borneo Herald*, that in October, last year, eleven large steamers —bound to New York, to Natal, to Madagascar in the west, to Calcutta in the north, and to Saigon and Hong-kong in the east —called at Labuan for bunker coal. Homeward-bound steamers also call for coal at Labuan, notably the Glen line, and I understand that other lines are willing to burn Labuan coal provided they are guaranteed a sufficient quantity. The output at present is about 50,000 tons a year, but it can be increased.

The supply of world-bound shipping thus brought to our very door by reason of the Labuan and Borneo coal may we hope shortly be increased by the opening of other coalfields on the mainland, and also by the increasing export of North Borneo products.

The products we export on a large scale are timber, tobacco, and sago. Our sago has suffered in value owing to the want locally of a good supply of fresh water for washing purposes. The present railway, together with two short branch lines 16 miles in length, for which the Governor lately obtained the approval of the Court, will enable the raw sago to be brought up from the low-lying sago plantations and cleaned on one of the mountain streams near the main line. The sago mills have already been erected by influential Chinese, introduced from Singapore by our Governor, Mr. Birch. The merchants have also put up tapioca mills and have arranged to plant 500 acres of tapioca a year until 5,000 acres have been planted. They are also planting cocoanuts on the same land to be a permanent crop after the tapioca has been dug up.

To sum up the question of transport I may remark that we are still handicapped by the want of a regular line of steamers to Europe, which has caused our foreign transport to be very costly, and in some cases has prohibited exports, but we now see reason for expecting that we shall shortly have homeward-bound steamers calling at our new port Jesselton, in Gaya Bay, to carry away sago, tapioca, tobacco, timber, and probably coal, besides the usual jungle produce such as rattans, gutta and rubber, and for this, when brought about, our thanks will be due to the policy of progress initiated and pushed by Mr. Cowie. Personally, as Commissioner of Lands, I have always advocated progress. From the first I have been a strong supporter of the railway policy, and I made a favourable report on the feasibility of constructing a railway up the difficult Padas valley to the interior. That my report was reliable is confirmed by the fact that the railway is now within 12 miles of the proposed terminus, Fort Birch. When it reaches that point a great portion of the interior will be accessible, as will also the untouched timber forests below Fort Birch. To date, over 100 miles of railway have been constructed, and, as I said at the North Borneo dinner, we have embarked on a policy which will not stop until the whole of Borneo is one network of railways.

Timber.—The timber trade of North Borneo has undoubtedly been very beneficial in the advancement of the country. We have immense forests, which led to a trade with China, and two steamers of about 1,500 tons have been making monthly trips to Hong-kong since 1896, taking full cargoes of timber, and a third steamer has lately been engaged in this trade. We have also supplied the Manila Railway with several cargoes of sleepers. At Sandakan there are two large saw-mills, which supply sawn timber to the neighbouring Dutch islands, and I am glad to say that our American neighbours in the Philippines are also good customers. At Kudat, also, there are very extensive saw-mills, which are turning out excellent planks and railway sleepers.

The steamers engaged in the timber trade with China, bring Chinese, Japanese, and Philippinos, who desire to work, or to settle in our territory. In December, 300 Chinese

arrived in North Borneo, and 450 more came in January. The Governor has advised the Court that, in 1903, there will be a stream of Chinese immigration, which will, undoubtedly, increase as the years roll on.

You are probably aware that the Chinaman is taxed in Canada, and that he is excluded from Australia and the United States. The only countries where he is freely admitted are Mexico, Malay Peninsula, and the islands in the Malay archipelago. Chinese labour has lately been so much referred to that I should like to mention that it is not easy to induce Chinese to leave China. The Mandarins object to the taxpayer leaving China, the Christian missionary in China objects to losing his converts, and the Chinaman does not wish to leave China. The only practical inducements are cheap land and the knowledge that he can work on his own account, both of which we are able to offer. I may mention that an able-bodied Chinaman contributes, indirectly, fully over 20 dols. annually to the revenue, so that any reasonable expense incurred in bringing Chinese to North Borneo is a decidedly profitable investment. The cost of introducing Indian coolies is about 60 dols., and we find we can introduce Chinese settlers and coolies with less difficulty and less cost.

The prosperity of Kudat I attribute to the introduction of Chinese settlers in 1883, and to the low price charged, in the first instance, for land.

The planting of coffee and cocoanuts near Kudat was largely due to the Chinese hand sawyers. Attracted at first by the fine timber near Kudat, they made vegetable gardens round their huts, and the richness of the soil led to their planting coffee and cocoanuts. The cultivation of coffee has received a severe check by the low prices ruling for some years, but cocoanuts are sufficiently remunerative, and the Chinese have lately begun to make cocoanut oil both at Kudat and at Sandakan. Cocoanut cultivation is rapidly increasing in North Borneo, and is taken up by natives, Chinese, and Europeans. At Tawao, the cocoanut palms already extend three miles along the sea front, and promise to be exceedingly remunerative.

At Sandakan, a company is engaged in the extraction of a dye from the bark of the mangrove, which also yields tannin. This promises to be a very large business in North Borneo. We have about 1,000 miles of sea frontage, and assuming that only 500 miles is edged with mangrove, there is room for twenty-five mills, allowing twenty miles of mangrove to each mill, which is sufficient to ensure a perennial supply of mangrove bark. I am told that the tanners in England could use 100,000 tons of mangrove extract annually, provided quantity and even quality are guaranteed.

Tobacco. — The annual exports of estate tobacco, which is almost entirely used for covering cigars, is about 20,000 bales, valued at £10 to £40 a bale. The tobacco industry in North Borneo has been a prosperous one for some years, and we hope to see it greatly extended. The best result for the 1901 crops was obtained by the New Darvel Bay Tobacco Company. On an expenditure of about £36,000 they received in Amsterdam over £72,000, or about double what the crop cost them to grow.

Minerals.—Gold and coal have long been known to exist in North Borneo. At one time the alluvial gold field round Darvel Bay and on the Segama River seemed likely to be an attractive one, and in 1888 nearly 100 Chinese were washing for gold on what is now the Darvel Bay Company's Tobacco State; but in those days we had no regular steamer to Darvel Bay, the miners had to pay heavy prices for provisions, and what I believe may yet be a profitable gold field ceased to be worked. In Sarawak and in Dutch Borneo, the alluvial gold is worked by Chinese settlers. These people make a living by agriculture, and they have all the comforts afforded by the presence of their wives and families. I believe that, had our Chinese gold workers had similar facilities as those in South Borneo, we should, to-day, have had a large gold-working population in Darvel Bay.

Coal is being prospected for by a syndicate, and their engineer, Mr. Phillips, has lately located, and traced for a mile, a three-foot seam in the vicinity of Cowie Harbour, on the east coast, and it is confidently anticipated that this seam will shortly be worked. Coal also exists at Naloyan, near the railway. In 1902, a very important mineral concession was granted to an influential syndicate on the understanding that a large sum of money is to be spent annually on prospecting. This syndicate has lately sent out a number of experienced prospectors to explore our territory, and has offered a reward for finding minerals. A lode of manganese, yielding 56 per cent. of the pure ore, was lately found by Mr. John Carnarvon on the Borneo Coffee Company's estate in Marudu Bay. This valuable find, together with the fact that both coal and

iron ore are known to exist in Borneo in large quantities, points to the possibility of North Borneo becoming a steel-producing country. Copper and antimony are both believed to exist in North Borneo. Platinum is found in small quantities in conjunction with the alluvial gold in the Segama River. Mineral oil oozes out in various places, notably in the Sequati River, at the extreme north of the territory, and on the Klias peninsula. From this you may gather that there are great possibilities for the prospector in North Borneo.

Religion and Education.—With regard to religion and education, the Roman Catholics were the first to send a priest to North Borneo. In 1881, the year of our charter, the present Pope, Leo XIII., requested the Rev. Father Jackson, to report what could be done to introduce religion and civilisation among the natives of Borneo, and missions have since been established on three rivers on the west coast under priests, who impart knowledge to the natives in their own language. At Sandakan, on the east coast, large schools for boys and girls have been established under the charge of two priests and four nuns, where education is imparted in English.

The Society for the Propagation of the Gospel sent to North Borneo in 1888 the Rev. W. H. Elton, who has established schools and churches in Sandakan, Kudat, and Labuan. At Kudat, the Rev. Mr. Richards, holds a service in Chinese for the benefit of about 700 Chinese, who, before emigrating to Borneo, were converted to Christianity by the Geneva Mission of Hong-kong.

Sandakan is the capital of British North Borneo. When Mr. Pryer, the first resident, went to Sandakan Bay in 1878, the town consisted of seventeen shops and some native huts, and was situated in an obscure corner fifteen miles up the Bay. A few months later it was burnt down, and Mr. Pryer selected the present site, near the entrance of the Bay. It is somewhat difficult to realise the change that has taken place. In 1882 there was a small land boom at Saudakan, and on the east coast, which continued into 1883. Chinese were coming in hundreds every month. Shops sprang up rapidly, and, when I arrived on the scene in 1883, I found an extraordinary collection of houses, and a very busy town.

In 1885, a fire was caused by a Chinaman roasting a pig, and the whole of the Chinese quarter was destroyed. The town was rapidly rebuilt on an approved plan. The houses are chiefly of wood with iron roofs, and are built over the water; but reclamation is going on; the ground is being raised, and brick houses are being built.

In 1888 we had a bigger land boom, brought about by tobacco planters. The land office sold over half a million acres, and the cash received by the land office in three years, 1888, 1889, and 1900, amounted to £117,000 sterling or, say, £39,000 a year. I am glad to mention these two land booms, because it affords an idea of what is possible in the future.

I say it is difficult to realise the change that has taken place at Sandakan since Mr. Pryer selected this site for the town. The first Governor, Mr. W. H. Treacher, told me that he visited Sandakan Bay, in 1872, in H.M.S. *Modeste*, and as they returned down the Bay, the commander fired two shells at a white cliff in the jungle. In 1885, when we levelled the top of the cliff, on which the Government offices are built, we found a seven-inch shell. That will give you some idea of the change effected since 1881. We have replaced the jungle by a town. The revenue of Sandakan, in 1881, was 20,000 dols. and last year's estimate was 367,000 dols., or eighteen times increase.

The site for the town of Kudat was selected on account of its excellent harbour. Like Sandakan it was uninhabited, and the land was covered with jungle. The timber was valuable, and shortly after my arrival at Kudat in 1883, where I took charge of the public works department, I obtained permission from the Governor, Mr. Treacher, to spend a hundred pounds on an experimental shipment of timber to Hong-kong, which, I am glad to say, helped to pave the way to our present timber trade. It will interest you to hear that one tree measured before it was cut into convenient lengths about one hundred and eighty feet from the ground to the topmost branch.

The population of Kudat (about 1,500 souls) is included by the last census in Marudu Bay, where the population is 16,316. The revenue of the Kudat district in 1881 was 14,000 dols., and last year's estimate was 154,000 dols.

There are five large tobacco estates near Kudat besides coffee and cocoanut plantations.

Kudat was cut out of the jungle by Mr. Alfred Everett. While so employed, it was arranged that a steamer should call periodically with food supplies. Some hitch occurred, and on one occasion Mr. Everett and all his coolies were without food, and were actually leaving the new township, when they saw a steamer approaching. I have known Sandakan in

former days almost at famine prices, and, looking back, I think a great deal of credit is due to the administration in North Borneo that so many stations should have been opened with so few exciting incidents on our records.

The importance attached to Jesselton by the Court of Directors may be gathered from the suggestion, already made, to remove the administration from Sandakan to Jesselton. I first landed at Jesselton in the beginning of the year 1900 to lay out the new town. At that time none of the houses displayed on the screen were built. There was only one native hut on the plain, which was then used as a grazing ground. A great change has since been made. This is entirely due to the railway, which now runs from the wharf at Jesselton through a fairly populous dristrict for 57 miles, to Beaufort, thence to Rayoh 21 miles, and is being continued to Fort Birch, in the interior, another 12 miles, or say 90 miles without a break, to which must be added the connecting line, 20 miles, from Beaufort to Port Weston, in Brunei Bay, which has been working for two years.

The harbour of Gaya, in which Jesselton is situated, has long been looked upon as an important one by His Majesty's Government. It has been recommended, by those best qualified to give an opinion, as a naval station and as a base to command the China seas, and it would be a convenient port of refuge in war time for English shipping.

The railway is now an additional reason, as it could bring down large supplies of cattle and food from the fertile districts of the Padas and from the villages along the railway.

The revenue of Jesselton is rapidly increasing. This is to be expected from the opening up of the country by the railway, which is giving a great impetus to trade and agriculture. Previously the shopkeepers in the villages along the line of railway obtained their supplies from Labuan by small trading vessels. They now find they can get supplies direct from Singapore to the railway terminus at Jesselton without the expensive transhipment at Labuan, or the dangerous transport in small craft from Labuan, which was formerly necessary. To the Administration, this concentration of trade at one port, which is entirely due to the railway, is of the very greatest importance, as it facilitates the collection of Customs and prevents smuggling.

At the back of Jesselton, and within say three miles, the coast range of hills begins to rise, culminating in the great mountain Kinabalu, 13,700 feet high. Apart from their picturesque grandeur, these mountains offered great possibilities for tea planting and for other products. Some of the natives who live on the slopes of Kinabalu raise a very good tobacco, which is exported to Brunei to the value of some 6,000 dols yearly. The present export is very small, but cultivation of any kind has always been carried on by the natives of the interior under very adverse circumstances. This tobacco is cultivated at a distance of two days' journey from the coast, and it has to be carried by the natives, on their backs, through the jungle. These interior natives also raise a very good rice, but they have had no incentive to grow more than they could eat, owing to the want of roads and means of transport. This is now receiving attention, and we may shortly see a great increase in the export of native-grown produce.

The indigenous rubber and guttas of North Borneo are of importance. On the Telicosan River, a tributary of the Padas, in the far interior, the natives cultivate a rubber-yielding creeper called *Menugun*. I am told it grows to a very large size, and yields a considerable quantity of rubber annually. The red gutta growing in the forests round Sandakan Bay, is well-known as *Dichopsis* or *Pallaquium longifolium*. It is valued at over five shillings a pound. A company has lately been formed to plant this and other guttas, also rubber, in North Borneo.

I have now concluded my paper on British North Borneo. I have tried to give you an idea of the country as it now is under the rule of the chartered company. We have done good by our administration. How much has been done in the last 22 years is difficult to explain, but 60 years ago a forecast was made by Captain the Hon. H. Keppel, whom you all know as Admiral of the Fleet, in his report on his expedition to Borneo in H.M.S. *Dido*, which I will read as it helps me to explain what the chartered company is striving to achieve.

"Should so fortunate an occurrence ever fall to the lot of Borneo—should a strong and a wise Government ever be established on her shores; a Government that will religiously respect property, and secure to industry the fruits of her labour; that will, by a wise system of laws, protect the peaceable, and punish the violator of the laws of a well-organised society; that will direct the industry of the people to useful purposes, and check their propensities to violence and plunder—such a Government, in a short series of years, would behold, as if by magic, a paradise burst from her wilds, see cultivation smile upon her jungles,

and hail a vast and increasing population, blessing the hand that awoke them to life, to happiness, and to prosperity."

DISCUSSION.

The CHAIRMAN thought he was only expressing the unanimous opinion of the meeting in saying that Mr. Walker had placed before them not only a valuable, but also a very satisfactory and hopeful view of the position of affairs in British North Borneo. As he had never had any personal connection with the country, nor approached its shores nearer than the neighbouring Philippine Islands, they might wonder why he was in the chair. He could not tell them why he was invited, but would give three reasons why he heartily accepted the invitation, and, in doing so, would put before the meeting the grounds upon which he thought the people of this country ought to feel a deep interest in their possessions in the Island of Borneo. The first reason was not connected with the State governed by the chartered company, but the adjacent territory of Sarawak; and if some might not think it a very practical reason, as it was not founded upon money, it must be remembered that sentiment had played a very considerable part, not only in building up the British Empire, but also in all the great movements of the world. He wondered how many people remembered that this year, 1903, was the centenary of the birth of Rajah Brooke. Forty years ago, Rajah Brooke's name was a household word in this country. He (the Chairman) was never likely to forget the effect that the story of Rajah Brooke's career had on his youthful mind, and he earnestly trusted that his memory, and the memory of Borneo, where he carried out his work, might always be cherished by the British people. Rajah Brooke was one of the most remarkable Englishmen that the 19th century produced. He was gifted with a rare combination of original conception, imagination, power of organisation, courage, judgment, and persistence. He was, of course, an adventurer in the original and honourable sense of the term, because he had not the assistance of the Government of his native land. But a good many of the heroes of the Elizabethan age were also adventurers. So was Charles Gordon when he led his ever-victorious army in China, or when he was facing fanatical tribes at Khartoum; in fact, he believed it was Gordon himself who said that England owed more to her adventurers than to her Governments. Certainly on the continent of Asia the foundations of the Indian Empire were laid by a company of adventurers; on the continent of America a vast territory of untold potentialities was due to the Hudson's Bay Company; on the continent of Africa the Imperial British East Africa Company laid the foundations of our Eastern possessions, and in the south of that continent, but for the timely action ot the late Mr. Rhodes in founding the British South African Company, the paramountcy of Great Britain from the Cape to the Zambesi and beyond would not be as it is to-day an accomplished and immutable fact; and returning from those three continents to the Island of Borneo, they found the northern part a British possession, thanks entirely to the courage and enterprise of another chartered company, the North Borneo Company. That was the second reason why he was present. He was glad to express his sympathy with the work they had done. It was one thing for an Imperial Government to enter upon the acquisition or the development of a new territory; because they knew that in the case of the unexpected turning up—and it was generally the unexpected which did turn up—they could rely upon practically an unlimited purse, so that in the event of initial failure it could be repaired, even though so repairing it might cost them 200 million sterling. But it was not so with a company such as the British North Borneo Company. The founders must have always felt hanging over them the fear, in the early stages especially, that initial failure might be final failure; and he thought everyone in the country who valued enterprise and pluck ought to feel a deep interest in the work of the British North Borneo Company. His third reason referred to an allusion made by the author to a suggestion that there should be a naval station in that part of the world. In the presence of Admiral Fremantle he did not intend to give any opinion on that subject from a naval point of view, but from a general point of view he had always been of opinion, since the question was mooted, that it was one of the many steps which England ought to take to secure her position in the Pacific. A great many people felt that the chief international struggle of the 20th century would be, he would not say for supremacy, but for commercial development in that quarter of the globe, and although they all hoped that competition would be pacific in every sense of the word, yet the best way to make it pacific was to be thoroughly prepared. There was one other point in the paper to which he wished briefly to refer, that relating to Chinese labour. He had so often expressed his conviction of the inevitable destinies of the Chinese race in every part of the tropics, where the white man either would not or could not perform manual labour, and where large and industrious native populations were not available, that he feared he would be branded with the reputation of a man with only one topic; but in view of the author's remarks, with most of which he agreed, he wished to throw out two concise suggestions. The first was that the already considerable emigration from China to the Philippines, the Straits Settlements, Burma, and other parts of the world had been furnished almost entirely from a very small fraction of the whole area of the Chinese Empire. The other suggestion was that the ever-growing pressure of the Western world upon China had already weakened, and was likely before long, whether for good or evil, to entirely demolish that great wall which Mandarin Government had raised between a quarter of the human race and the rest of mankind.

Sir JOHN JARDINE, K.C.I.E., said he would not follow the present state of Borneo, which the author had dealt with so fully, but would direct attention to the past of the country. Long ago North Borneo was a British possession but was abandoned by the East India Company. In the year 1763 the Government of Madras fitted out an expedition and took Manila from the Spaniards. There they found the Sultan of Zulu in one of the dungeons, and having delivered him from that dungeon, that Sultan gave the East India Company the concession of which they availed themselves. They started a factory in the Island of Balambangan and stopped there for a long time; and in the India Office beautifully drawn charts of the coast might be seen, made in the year 1763, describing the place and the products, and stating that cargoes might be got of such things as edible birds' nests, beeswax, lacquerwood, dammer, cloves, pepper, camphor, and cinnamon, while nearer to Sandakan there was an export of soft gold. Those things were highly valuable products, and if they were to be found then it was to be hoped they were to be found there still. Mr. John Jesse, the chief of the factory, went to Brunei, which he called in his letters Borneo Proper, and there planted pepper, building up a valuable business, as he obtained a monopoly of that article from the Sultan of Brunei. In 1775 we moved the factory to Labuan which, however, we abandoned in 1803. Long before, in that great age of enterprise when the East India Company was founded, the first English captains went to the ports of Borneo. If one went to the India Office and inspected the manuscripts of printed books it would be found that in the early years of James I., the merchants of the East India Company were trading at the ports on the western side, Succandana, Sambas, Landak, and Banjermassin, now belonging to the Dutch, and doing a trade in diamonds and gold. For reasons upon which he need not dilate, the East India Company felt it was not worth while keeping the concession, and that fine country, a region about as large as Ireland, might have been lost to England if it had not been fished out of the sea first by the exertions of Rajah Brooke and then by Mr. Martin, Mr. Cowie, and the founders of the British North Borneo Company, who in that way restored what was now becoming a fine colony to the British Empire. Some remarks had been made about Chinamen. If reference was made to the records of the very earliest mariners it would be discovered that they were in Brunei at the time of the English Tudor Kings. Coming nearer to our own time, Sir Stamford Raffles had made the very striking statement that in those days there was an export of gold dust from Montrado on the western coast of Borneo of about half a million sterling a year, and it was said in the record of the trading that there were no less than 32,000 Chinamen situated at the place who sent to their wives and families in China somewhere about £153,000 a year in the shape of fine gold. Those were important facts, and almost made one look with a rosier view on the position of the company. As a servant of the Indian Government he need hardly say that his interest in Borneo began from the fact that on reading a little about the country it struck him it was a small East India Company in the germ. In some respects it had a better chance even than that, the greatest institution the city of London ever had. One part of the policy of the chartered company was that it did not have a monopoly of trade, and hardly indulged in trade itself. It left to all enterprising merchants a fair field for them to carry on their commercial enterprises, while the company, as a government, secured peace, made roads and railways, and laws for the people who resorted there or brought their capital. That, he thought, was an immense advantage. The founder of Singapore, Sir S. Raffles, foresaw that a commercial settlement might succeed in Borneo where a trading government would fail. The time of acquisition of territory seemed now to have come to an end. The latest annexation had brought them co-terminus with the neighbouring protected State of Brunei; for it might not be known to everybody that the chartered company was one protected State, Brunei another protected State, and Sarawak a third protected State, all under the British crown. The time of consolidation also seemed to have passed; the time of inside development had now begun, and all this had taken place in about 22 or 23 years. A question was often asked, particularly by anxious shareholders, as to what the future would be. It was not easy to forecast the future. The author had shown that the development of many industries was going on, and the Chairman had laid great stress on the use of Chinese labour as essential for the future development of that part of the Company's operations. He thought there could be no doubt about that. North Borneo was both a political government and a territorial estate. From what he had read about the country and looking at the photographs, it had struck him there was a great deal of analogy between North Borneo and the Indian province of Burma, where he (Sir John) had spent some years. The climate and productions were much the same, and there was a good deal of resemblance in the way of buildings, and the habits and traits of the people. Looked on as a territorial estate, there seemed to be no doubt that Burma was already beginning handsomely to pay the Indian Government. The same result might be expected by adopting the same means in Borneo, namely, by encouraging commercial enterprise, by providing railways and feeder railways, by fostering a great ocean trade, by inducing Chinamen to settle, and, if possible, by getting returning steamers to call at Borneo ports for cargo. He thought that was a fairly reasonable view to take of the prospects of North Borneo. Again, as compared with some English protectorates, and with the East India Company, no debt had been accumulated by the chartered company in the shape of great wars or anything of that kind. It had started with a

small capital, as compared with its achievements. Looking at the frontiers, it would be seen that the country on two sides was surrounded by the sea. On the southern side were the peaceful Dutch, and there had never been any suggestion that we should raid their territory, nor had they the slightest inclination to have any quarrel with us. To the north the Americans had now become our neighbours, and, as the author had shown, that was increasing trade. Supposing there were to be any political disturbance in the interior, the Government would be able to call on the military at Singapore, which was practically near, so that it saved the expense of keeping up anything like an army of its own. Secondly, the ports and bays had long been known to the Admiralty more, perhaps, than to any other class of British subjects. With such favourable bays, and the Admirals occasionally calling there, the country had another great protection on the two frontiers which he had described as the sea.

Mr. Richard Biddulph Martin, M.P., said that although he had never been in Borneo, he had been connected with it from the very beginning of the chartered company, and, in fact, was in the House of Commons at the time when Mr. Gladstone made his speech advocating the grant of a charter to the company, for the better protection, as he said, of enterprising Englishmen who carried their enterprise beyond the borders of the Empire. He well remembered the discussion which took place in Parliament on the grant of the charter, the chief opposition coming from the late Mr. Peter Rylands, Sir Wilfrid Lawson, and others, who took up the ground that the company did not in the charter propose absolutely and immediately to abolish slavery. The history of the company had shown how wise the decision was. It was known that the question of slavery had been a burning one for many years in Zanzibar, the Island of Pemba, and other places in the British Empire, but in less than two years after the company had started its operations, slavery in Born o was practically unknown. If it still lingered in the haunts of some people under the Mohammedan domestic rule, slavery of that kind was nothing more than the intelligent supervision by the head of the household over the young people connected with it. That showed the wisdom of the course adopted, and indicated how all-important it was that dealings in such matters should be left to people on the spot, who should not be tied down to any hard and fast line. In that manner things which every Englishman wished to see done could be performed much more quickly than would be possible if controlled by Government offices thousands of miles away. The author most properly alluded to the great importance of the Island of North Borneo as a stragetical position in that part of the world. He wished to point out that taking the triangle representing roughly Hongkong, Singapore, and Australia, Borneo stood in the middle. There was no doubt that in any future war between civilised countries the cutting of cables would be one of the first duties of opposing powers. The positions of the cables were perfectly well known, not only by our officers, but by those of other powers. Therefore he wished to call attention to a matter, which perhaps a week ago would have only been of general interest, but was now of considerable importance. On the previous day for the first time a business message had appeared in the *Times* transmitted by wireless telegraphy from America. He wished those present to think for a moment how important it would be to the interests of Great Britain to have a central position from which telegrams could be flashed without the use of wires to Singapore, Hongkong, and Australia, and even to more distant places. Many present were old enough to remember the messages that were for a moment flashed across the Atlantic when the electric cable was first laid, and the dead silence that then came; but a few years after the bottom of the Atlantic was lined with cables sending their messages every day. He did not for a moment suppose that the Marconi system was perfect, or that it would not be capable of great improvement, but it was an established fact that wireless telegraphy could be carried out; and the position of North Borneo warranted him in supposing that it would be a most important centre for anything of the kind to the British Empire in that part of the world. No speaker had referred to the magnificent mountain which towered from the centre of Borneo, Kina Bahu, called the Widow of China. It was 13,800 feet high, almost up to the snow line, even in the equator. The possibilities of sanatoria at something approaching that height, giving a complete change of climate, was a suggestion which he always thought might be made use of hereafter. There was no doubt the country was progressing, and the effects of civilisation were being constantly experienced among the natives. The services of the ladies who spent their time and efforts in taking care of the natives were highly appreciated. It might be a lesson to some people if he said that one of the greatest curiosities was the manner in which vaccination "caught on" among the natives. He had been told they had come in tens and twenties, bringing their children with them, to be vaccinated, because they were convinced of its protective effect against that awful scourge, small-pox, although for many years difficulty was experienced in keeping a supply of lymph suitable for the requirements of the place. The whole country was full of possibilities. Gold and diamonds had been found, the largest diamond in the world being said to have come from North Borneo. Coal, manganese, and other materials were also present in the country. There were all kinds of possibilities in a country of the size of Borneo, whose geographical configuration was so varied, with its mountains, torrential rivers, and great expanse of forest land. The timber of the country was peculiarly beautiful, there being many varieties which were admirably adapted for decorative purposes; for garden seats, and such things, it was

not to be surpassed or equalled by any wood which was ordinarily known in the trade. He hoped the realisation of all their schemes would be accomplished in due time. The Chairman had omitted to state the very great obligations which the Empire owed him (the Chairman) under circumstances of the greatest difficulty, for the way in which he had founded an Empire for the British Crown, which he hoped they, in Borneo, would succeed in copying, and on which, if possible, improving.

Admiral the Hon. Sir EDMUND FREMANTLE, G.C.B., said he had visited Borneo two or three times, the occasion of his first visit being in 1856-7, in the days of the great Rajah Brooke, to whom he was glad to hear the Chairman pay so eloquent a tribute. He again visited Borneo in 1893, when he was in command on the China Station. He wished to say a few words about the chartered companies and Rajah Brooke. He entirely agreed with what fell from the Chairman with reference to chartered companies. They might not all be equally good, but they possessed many advantages. Individuals or chartered companies, who were the pioneers of civilisation, like Rajah Brooke, or the British North Borneo Company, were able to deal with the natives in accordance with their own laws. He had been to Sarawak when a sort of quarter session was being held. The native chiefs were in charge, although some European was present superintending. The laws were administered to a great extent according to the native custom, tempered, no doubt, by that knowledge of civilisation which was inherent in the Englishman, and that Christianity with which he had been brought up. That, generally speaking, was far more suitable for the government of those countries than the distinct British law. Having visited protected States, and having also visited Singapore and Malacca, which were more directly under British government, he had no hesitation in saying that the protected States which were not so entirely ruled in accordance with British law, advanced more rapidly, on the whole, were more satisfactory than those British colonies which were directly under the crown, and were much less expensive. With reference to the naval port which had been spoken of, that question naturally came before him when he was on the China station. But at that time there was a much more burning question being discussed, namely, that the only cable to Hong-kong went through the French establishment at Saigon. That state of affairs was remedied shortly afterwards by carrying the cable to Borneo, and it was no doubt a most important matter that it should be properly defended. When the Government was pressed to have a naval base here or there, although he was quite aware of the absolute necessity of it in some cases, every naval base must be considered on its merits. Any naval base was absolutely useless unless a certain amount of money was expended upon it; stores and provisions must be accumulated, and, if it was to be a satisfactory base, docks, and means of repair were required, and so long as they could do without them they had better do so. The time would come probably when it would be found necessary to have such a naval base. He had not the slightest doubt that when the Pacific was of more importance than it was now—and undoubtedly all countries of the world were united in endeavouring to make the Pacific a far less pacific place than it was at the present moment—it was probable that a naval base such as was spoken of by the author would be required. The harbour of Sandakan was an extremely good one, and had great possibilities; but in going to North Borneo it must be remembered there were a great many reefs to pass through, and although they were not such as to offer any real difficulty to good navigation, naval officers liked, as a rule, to have a naval base which could be got at easily. That was the principal advantage of the proposed naval base at the Firth of Forth; it had that advantage over other naval bases suggested on the east coast of England. He believed Borneo was a country of great capabilities, and agreed with the Chairman that such countries, in the first instance, at all events, were far best developed by companies, who were independent of the strict laws of England, and the necessary expense which naturally followed and could not be avoided in all British colonies.

Mr. WALKER writes:—With regard to the remarks (which I had no opportunity of replying to) made by Admiral Fremantle, I should like to point out that, although Sandakan does not come up to the Admiralty requirements Gaya Bay, on the west coast of North Borneo, the harbour to which I referred in my paper, is eminently suitable in every respect as a naval base. It is easy of approach, its position is on the highway of the whole of the European and Indian trade to and from China; the harbour is practically land-locked, and its physical features are splendidly adapted to the construction of inexpensive defence works. The harbour is already connected with the interior by over 100 miles of metre gauge railway, which taps rice-fields, valuable sago and timber forests, and also a coal-field at Naloyan. It would not require a large sum of money—as money is spent now-a-days—to make Gaya Bay a great naval port, with the necessary docks, and to render the Bay absolutely impregnable. In view of the fact that the Far Eastern question must be ultimately settled in the China Sea, His Majesty's Government, after spending so many millions in Africa, and now again in Ireland, will surely not be averse to a comparatively small expenditure which would make North Borneo a naval base with a coal field and a telegraph cable at command. Singapore and Hong-kong must import all the coal they use. Our output is now about 50,000 tons a year, which can be largely increased if inducement is offered.

On the motion of the Chairman, a hearty vote of thanks was accorded to Mr. Walker for his paper.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evening, at Eight o'clock :—

APRIL 22.—" Modern Bee-Keeping." By WALTER FRANCIS REID, F.C.S. ELLIOTT DOWNS TILL, late Vice-President of the British Bee-keepers' Association, will preside.

INDIAN SECTION.

Thursday Afternoon, at 4.30 o'clock :—

APRIL 23. — " The Province of Sind." By HERBERT MILLS BIRDWOOD, C.S.I., M.A., LL.D. The EARL OF LYTTON will preside.

COLONIAL SECTION.

Tuesday Afternoon, at 4.30 o'clock :—

MAY 5, at 4.30 p m.—" The Lagos Hinterland : its People and its Products." By MAJOR J. H. EWART.

APPLIED ART SECTION.

Tuesday :—

APRIL 28, 7.30 p.m.—Visit to the Whitefriars Glass Works. Paper by Mr. HARRY POWELL on " Modern Table Glass." (Special tickets required.)

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 20...Surveyors, 12, Great George-street, S.W., 4 p.m. Mr. H. Trustram Eve, "Modern Methods of Valuation of Manurial Residues."

British Architects, 9, Conduit-street, W., 8 p.m. Paper by Mr. E. T. Hall.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. 1. Prof. J. W. Spencer, "The Geological Conditions of the West Indian Volcanoes." 2. Prof. J. Logan Lobley, "Volcanic Action, with special reference to the recent Irruptions in the West Indian Islands."

TUESDAY, APRIL 21...Royal Institution, Albemarle-street, W., 3 p.m. Prof. A. Macfadyen, "The Blood and some of its Problems." (Lecture I.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Messrs. James Tayler Milton and William James Larke, "The Decay of Metals."

Statistical, 9, Adelphi-terrace, Strand, W.C., 5 p.m. Mr. A. Wilson Fox, "Agricultural Wages in England and Wales during the last Fifty Years."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. R. I. Pocock, "The Geographical Distribution of Spiders of the Order Mygalomorphæ." 2. Mr. Oldfield Thomas, "Some Mammals collected by Capt. H. N. Dunn in the Soudan." 3. Mr. Henry Scherren, "Linnæus and Hunter on Feather-tracts."

WEDNESDAY, APRIL 22...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Walter Francis Reid, "Modern Bee-Keeping."

Chemical, Burlington-house, W., 5½ p.m. 1. Messrs. F. G. Donnan and R. le Rossignol, "The velocity and mechanism of the reaction between potassium ferricyanide and potassium iodide in neutral aqueous solution." 2. Mr. G. Barger, "A microscopic method of determining molecular weights." 3. Prof. W. N. Hartley, "Note on the spectrum of pilocarpine nitrate." 4. Mr. F. D. Chattaway, "Isomeric change of dipropionanilide into propionyl-p-aminopropiophenone." 5. Mr. W. R. Lang, "Note on the formation of the di- and hexa-methylammoniacal chlorides of cadmium."

THURSDAY, APRIL 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. Herbert Mills Birdwood, "The Province of Sind."

Antiquaries, Burlington house, W., 2 p.m. Annual Meeting.

Society for the Encouragement of Fine Arts, 6½, Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. H. Beaumont, "Ruskin's Bible of Amiens."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, "Hydrogen—Gaseous, Liquid, and Solid." (Lecture I.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Messrs. A. D. Constable and E. Fawsett "Distribution Losses in Electric Supply Systems." 2. Mr. M. B. Field, "A Study of tho Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms" (Adjourned Discussion). 3. Mr. W. Aitken, "Divided Multiple Switchboards: An Efficient Telephone System for the World's Capitals."

Numismatic, 22, Albemarle-street, W., 7 p.m.

Mining and Metallurgy, at the Rooms of the Geological Society, Burlington-house, W., 8 p.m. 1. Mr. J. N. Justice, "Diamond Drilling in West Africa." 2. Mr. H. Kilburn Scott, "The occurrence of Mica in Brazil, and on its preparation for the market." 3. Mr. J. A. Woodburn, "The Working of a Wide Gold Quartz Reef in soft ground at Rezende, Rhodesia." 4. Mr. J. H. Ivey, "Notes on the Redjang-Lebong Mine, Sumatra."

FRIDAY, APRIL 24...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Hon. R. J. Strutt, "Some Recent Investigations in Electrical Conduction."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. H. S. Watson, "Bacterial Sewage-Disposal Works at Ash, Dover."

North-East Coast Institute of Engineers and Shipbuilders, Fawcett-street, Sunderland, 7.40 p m. 1. Discussion on Mr. J. Denholm Young's paper, "Loss of Power in Steamship Vibrations." 2. Discussion on Mr. F. H. Alexander's paper, "A Displacement Table for use with the Tchebycheff Formula." 3. Mr. Archibald Hogg, "Some Points in the Construction of Large Steel Steamers and the Riveting of Lapped Butts"

Mechanical Engineers, Storey's gate, Westminster, S.W., 8 p.m. 1. President's Address. 2. Prof. W. E. Dalby, "The Education of Engineers in America, Germany, and Switzerland."

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m. 1. "Exhibition of Elementary Apparatus," by Mr. Croft, 2. Mr. H. Darwin, "An Electrical Thermostat." 3. Mr. A. F. Ravenshear, "Dimensional Analysis of Physical Quantities and the Correlation of Units." 4. Mr. R. J. Sowter, "Note on the Dimensions of Physical Quantities."

SATURDAY, APRIL 25...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Langton Douglas, "The Early Art of Siena." (Lecture I.)

CORRECTION.—p. 502, col. 2, l. 6, *for* mediæval *read* medicinal; p. 503, col. 1, note, l. 14, *for* Nova *read* Novo.

Journal of the Society of Arts,

No. 2,631. Vol. LI.

FRIDAY, APRIL 24, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, April 27, 8 p.m. (Cantor Lecture.) W. Worby Beaumont, M.Inst.C.E., "Mechanical Road Carriages." (Lecture I.)

Tuesday, April 28, 7.30 p.m. (Applied Art Section.) Visit to the Whitefriars Glass Works. Paper by Harry Powell on "Modern Table Glass."

Wednesday, April 29, 8 p.m. (Ordinary Meeting.) T. A. Brockelbank, "Automatic Wagon Couplings on British Railways."

Further details of the Society's meetings will be found at the end of this number.

APPLIED ART SECTION.

The visit to the Whitefriars Glass Works of Messrs. James Powell and Sons, Tudor-street, E.C., will take place on Tuesday evening next, April 28th, from 7.30 to 10.30 p.m., when a short paper on "Modern Table Glass," will be read by Mr. Harry Powell, and the processes will be explained in the glass-house.

The accommodation is strictly limited and 100 tickets only will be issued. Each Member is entitled to apply for one ticket, which will be transferable. A few tickets still remain, application for which should be made at once. No one can be admitted without a ticket.

INDIAN SECTION.

Thursday afternoon, April 23, 1903; Sir William Lee-Warner, K.C.S.I., in the chair.

The paper read was "The Province of Sind," by Herbert Mills Birdwood, M.A., LL.D., C.S.I.

The paper and report of the discussion will be published in a future number of the *Journal.*

VIVA VOCE EXAMINATIONS IN MODERN LANGUAGES.

These Examinations are now held in French, German, and Spanish.

Certificates (of one grade only) are issued on the result of the Examinations.

The Examination will include Dictation, Reading, and Conversation. Candidates will be expected to satisfy the Examiner in all these branches.

They can be held at any date, at any of the Society's Examination Centres, where the Local Committee will undertake to make the necessary arrangements, and to pay a fee of 2s. 6d. per Candidate, for not less than 24 Candidates in each subject.

The Local Committee will be expected to pay the Examiner's travelling expenses.

The Committee may charge an additional fee to cover local charges. It is suggested that this fee should be kept as low as possible.

The Examinations in each Language are entirely separate and distinct.

Secretaries of Committees desiring to hold any of these Examinations, should inform the Secretary of the Society of Arts of the date on which it is proposed to hold it. He will then endeavour to arrange a date which may suit the convenience of the Committee and of the Examiner.

Further information can be obtained on application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

Proceedings of the Society.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 22, 1903; Elliott Downs Till, late Vice-President of the Beekeepers' Association, in the chair.

The following candidates were proposed for election as members of the Society:—

Aglen, Francis A., Custom House, Nanking, China.
Burdick, Charles L., The Aerograph Company, 30, Memorial-hall, Farringdon-street, E.C.
Clarke, H. E. C., Lealtad 6, Madrid, Spain.
Cornish, Tom, 81, Gracechurch-street, E.C.
De Châtelain, Prof. Michael A., Sosnovka, St. Petersburg, Russia.
Dolbear, Prof. Amos Emerson, Tufts College, Massachusetts, U.S.A.

Free, Rev. Richard, M.A., St. Cuthbert's-lodge, Millwall, E.
Ho Kai, Hon. Dr., C.M.G., M.B., M.R.C.S., 7, West-terrace, Hong Kong, China.
Kearne, Mrs. Isabel, De Lacy, 15, Duke-street, Southport.
Margetson, John, Brightside, Stroud, Glos.
Phillips, Thomas Brice, 4, Aylesford-terrace, Uckfield, Sussex.
Pole, Benjamin Charles, 19, Imperial-buildings, Ludgate-circus, E.C., and Clifton-house, Church-road, Upper Norwood, S.E.
Rayner, William George, 10, Arthur-street West, London-bridge, E.C.
Risch, G. H. C., M.I.E.E., Central South African Railways, Johannesburg, Transvaal, South Africa.
Robarts, W. E., 298, Smith-street, Durban, Natal, South Africa.
Savage, Dr. William Arthur, F.G.S., Mapumulo, Natal, South Africa.
Smith, James Henry, Kincraig, Tuxedo-park, New York, and 10, Wall-street, New York City, U.S.A.
Terry, Don Enrique, Chile, and care of Campbell, Everden and Co., Suffolk-house, E.C.
Wood, Thomas Megam, Galway-house, Maybank-road, South Woodford, Essex.
Wyatt, Charles H., M'Kopo Farm, Thaba 'nchu, Orange River Colony, South Africa.

The following candidates were ballotted for and duly elected members of the Society:—

Branford, Herbert Mills, F.C.A., 3, Broad-street-buildings, E.C.
Cowen, Charles, 5, Upper Woburn-place, Russell-square, W.C.
Dudley, Plimmon Henry, Ph.D., 80, Pine-street, New York, U.S.A.
Edwards, Charles Augustus, L.R.C.P.E., L.R.C.S., Sydney, New South Wales.
Francis, Arthur A., The English Crown Spelter Co., Ltd., Ponte di Nossa, Bergamo, Italy.
Lowenadler, Fred., 4, Fenchurch-avenue, E.C.
Mallet, Prof. John William, Ph.D., M.D., LL.D.. F.R.S., University of Virginia, Charlottesville, Virginia, U.S.A.
Mullins, John Henry, Preswylfa, Cardiff.
Newland, H. Osman, 126, Brixton-road, S.W.
Oki, Yoshinao, Takasima Colliery, Nagasaki, Japan.

The paper read was—

MODERN BEE-KEEPING.

BY WALTER F. REID, F.I.C., F.C.S.

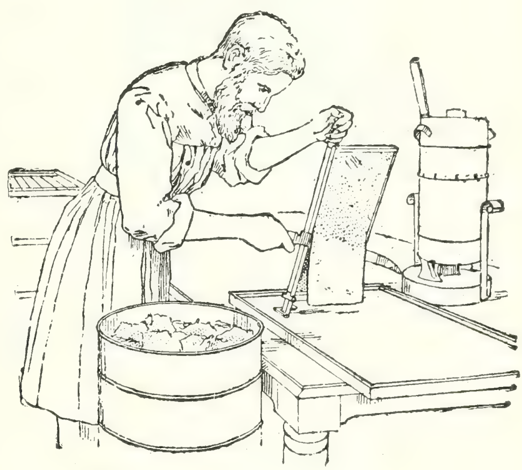
(Member of Council, and First-class Expert of the British Bee-keepers' Association.)

The industry of bee-keeping is one of the oldest, if not the oldest, of all the industries connected with agriculture. From the very earliest times we find references to bees and their products, and these references are of such a nature as to show an intimate knowledge of bee-keeping. In the Bible, for instance, beeswax or honey is mentioned more than 70 times. Honey was the only substance known to the ancients, capable of replacing our sugar, and, for a long time, it was the only substance available for preserving organic materials. The body of Alexander the Great was preserved in honey, and it has been recorded that Herod I. kept the body of Mariamne, his wife, for seven years in honey. Wax was of the greatest importance when candles and lamps were the sole means of illumination, and during the Middle Ages enormous quantities were consumed in the services of the Church of Rome. In those times bee-keepers had special rights and privileges, and formed powerful guilds, especially on the Continent. The introduction of sugar, together with the more extensive use of oils for illuminating purposes, brought about a decadence in bee-keeping, from which it is only now recovering. It has been fully demonstrated that honey has a dietetic value possessed by no form of sugar, while beeswax possesses properties not shared by paraffin or other mineral waxes and which are rapidly causing the demand for it to increase. One of the chief obstacles to a general restoration of bee-keeping to its former prosperity lies in some of the bee-keepers themselves. There are thousands of apiaries in this country the owners of which employ methods and appliances which the Egyptian of 4,000 or the Greek of 2,000 years ago would have condemned as obsolete. Fortunately the British Bee-keepers' Association, and the affiliated county Associations are working hard to spread the knowledge of more modern, humane, and remunerative methods, and their efforts are being rewarded with a gratifying amount of success. Some of the county councils are also doing good work, and under the new Education Act may do much to foster this important rural industry. In a few cases, however, the instructors appointed have not been sufficiently familiar with modern methods, so that their teaching must have a retrograde effect.

Before real progress could be made in apiculture it was necessary to obtain an intimate knowledge of the organisation and habits of the bees themselves. For centuries the wildest guess-work took the place of exact observation, even the sexes of the bees were hopelessly confused, and the Germans still refer to the drones in the female and the queen in the male gender. The man who of all others

contributed most to our knowledge of bees was Huber, the blind naturalist of Geneva. Although he was himself unable to observe, yet, with the help of others, he made most important discoveries, and, at the same time, laid the foundation for an improvement destined to revolutionise bee-keeping, namely, the hive with movable combs. In Huber's hive the combs were fixed in frames swinging on hinges, so that they could be opened out like the leaves of a book. While observations could be easily made upon bees kept in such a hive, yet the construction was expensive, the combs were not interchangeable, and there were other reasons why this invention was not suitable for the practical apiarist. Following Huber many attempts were made to construct hives with movable frames; but the first successful hive on modern principles appears to have been that of P. J. Prokopòvitsch, who in 1841 invented the system which contains the essential elements of our sections and shallow frames. He also used a grating as a queen excluder, and was thus enabled to secure comb honey uncontaminated by brood or pollen. As Prokopòvitsch had an apiary of two thousand eight hundred hives, at which the number of students was never less than eighty, his ideas spread rapidly. In Germany, Dr. Dzierzon used movable frames for the body of the hive, and has probably done more than any one else to extend the use of this kind of hive. In Great Britain, Mr. T. W. Cowan has been the apostle of the bar-frame hive, and in the columns of the *British Bee Journal*, as well as in numerous publications, he has rendered signal service to British bee-keepers. The movable frame had been invented and introduced into practice, but it still had one defect. In order to induce the bees to attach their combs to the upper bar of the frame, it was necessary to affix a piece of comb to the wood, and this method was adopted by Prokopòvitsch. The combs worked out by the bees were not, however, always straight, and consequently not interchangeable. It remained to find some means of compelling the bees to build straight combs in the frames, and here again the right man appeared in due course in the person of a Bavarian carpenter, J. Mehring, of Frankenthal. He found that when a sheet of wax is embossed with a pattern representing the base or foundation of the cells, the bees will adopt this work of human hands as their own, and finish off the cells thus sketched out for them. A frame filled with such a sheet of "foundation" ensured a straight comb, and thus in 1865 another important step in apiculture was made. Hitherto, in order to obtain honey it was necessary to crush the comb containing it, and strain off the honey from the fragments of wax. This was much to be regretted, not only because it took the bees a long time to build fresh combs, but also because they consumed about 10 lbs. of honey in order to secrete one pound of wax, and this had to be done in that short period of the year available for the honey harvest. It occurred to an Austrian officer, Major von Hruschka, in 1865, that the honey might be extracted without injuring the comb.

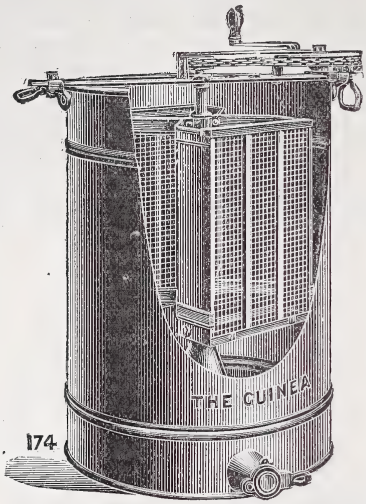
Fig 1.



He tried the experiment, and it succeeded. The method he adopted was to fasten the comb in a frame after the capping of the honey-cells had been pared off, and to revolve the frame rapidly by means of a string. Under these circumstances the honey flies out of the cells, leaving the comb uninjured and fit for re-filling by the bees. Fig 1. shows the operation of uncapping the combs by means of a knife heated by immersion in hot water. It is important that the comb be held slanting so that the capping detaches itself from the face of the comb when cut. After uncapping, the honey is extracted in a centrifugal machine known as an "extractor." One of the best and most widely-known forms of extractors is that shown in Fig. 2, as supplied by Mr. P. Meadows, of Syston. The chain gearing, by which it is actuated, runs so easily, that the work can be done by a child. After extraction, the combs are returned to the hives, and are re-filled by the bees. The modern bee-master,

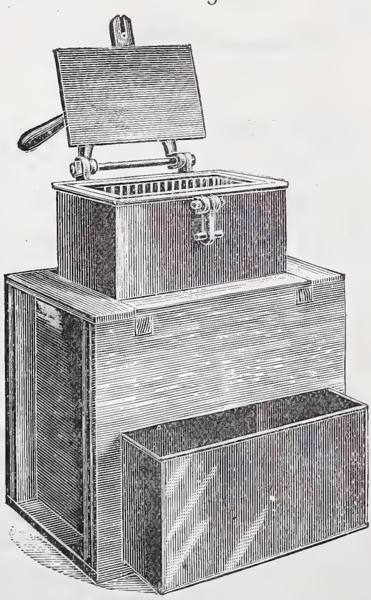
therefore, looks upon the combs as part of his plant rather than as a product of his apiary. The cappings of the honey-cells are melted down, and furnish the finest kind of wax.

FIG. 2.



Some kinds of honey are so thick, that they will not leave the cells, at any rate, not under the influence of a centrifugal force insufficient to damage the combs. Heather honey is a notable instance of this, and, in order to obtain

FIG. 3.



it in the pure form, it is necessary to cut out the combs and press them in a special press. One of the most recent is the Rymer honey press shown in Fig. 3.

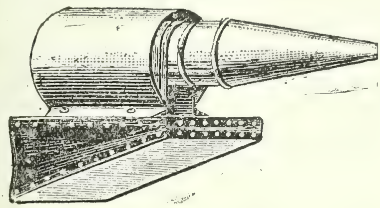
Many minor devices have contributed to the convenience and profit of bee-keeping in recent times. Among the most important of these may be mentioned the "queen excluder." In all combs to which the queen has access, she will lay eggs, from which brood will hatch, resulting in contamination of the honey. The up-to-date apiarist, therefore, confines the queen to the lower part of the hive known as the "body-box" or "brood-chamber." He does this by placing over the frames a grating or perforated sheet with holes sufficiently large to allow a worker-bee to pass; but too small to admit the queen, the diameter of whose body is somewhat greater. Drones are also excluded from the honey chambers in this way. The material generally employed for making queen excluders is zinc; but this is not to be recommended, because, being a good conductor of heat, it conveys the heat away, and therefore chills the brood-nest, and also prevents the bees from working in the "supers" at as early a date in the spring as would be the case were the zinc replaced by a non-conducting material. Such a non-conducting material suitable for the purpose is celluloid, which I have used for some years, with satisfactory results. Transparent sheets of celluloid are also very useful in the apiary for laying upon the tops of the frames. The movements of the bees can be seen through celluloid as readily as through glass, and each hive becomes, to a limited extent, an observatory hive.

Another appliance of great utility to the bee-keeper is the "bee-escape" or super-clearer. In order to remove the bees from the upper hive-chambers so as to secure the honey, it was formerly necessary to drive them off the combs by smoke, carbolic acid, or mechanical means, thus interfering materially with the work of the bees, and sometimes starting robbing in the apiary. Now, the bee-keeper slips a board containing a "bee-escape" under the portion of the hive which he wishes to remove, and the bees pass through it into the lower part of the hive, from which they cannot return. To amateurs and beginners especially, the "bee-escape" is a great boon.

Before manipulating bees, it is advisable to induce them to gorge themselves with honey, as they rarely sting when in this state. It has been known from time immemorial that when smoke was blown into a hive the bees at once rushed to their combs and filled themselves with honey. A regular supply of smoke is,

therefore, a necessity to those that are often handling bees, and numerous appliances have been invented to supply this want. I know

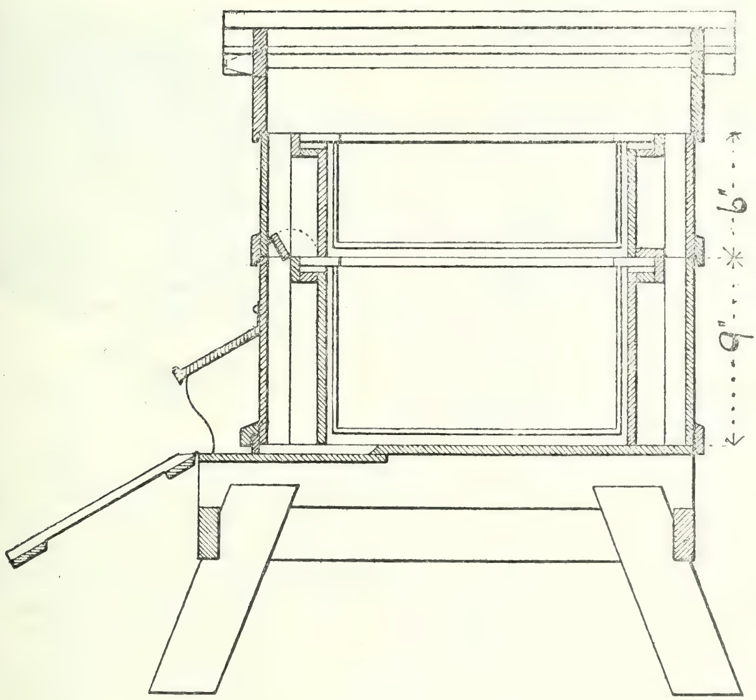
FIG. 4.



of no simpler or more effective "smoker" than the "Bingham," which is shown in Fig. 4 in the form made by C. H. Taylor, of Welwyn, Herts. The nozzle of this smoker is easily removed, a cartridge made of some form of cellulose is inserted, after lighting at one end, and the nozzle replaced; the small bellows attached to the cylinder of the smoker eject the smoke with considerable force, so that every corner of the hive can be reached. Many substitutes for smoke have been introduced; that most in use at present is carbolic acid, a solution of which is sprinkled upon a cloth or feather. In using either smoke or carbolic acid, caution is necessary, for honey has a very delicate flavour, and in judging at shows I have frequently found otherwise excellent honey tainted by offensive smoke or carbolic acid.

The aids to bee-keeping are now so numerous as to be a source of bewilderment and embarrassment to beginners, and the well-filled catalogues of dealers in bee-keeping appliances are apt to create an erroneous impression that bee-keeping is an expensive hobby rather than a remunerative industry. Those who intend to commence bee-keeping and have no expert friend to advise them as to which articles are necessities, and which merely conveniences, are recommended to obtain a beginner's outfit, which is supplied by most appliance manufacturers. Messrs. Lee and Son, of Silver-street, Holborn, have been kind enough to send one of their well-known outfits, which you will notice is not of a very complicated nature, and yet contains all that is essential for a beginner.

FIG. 5.

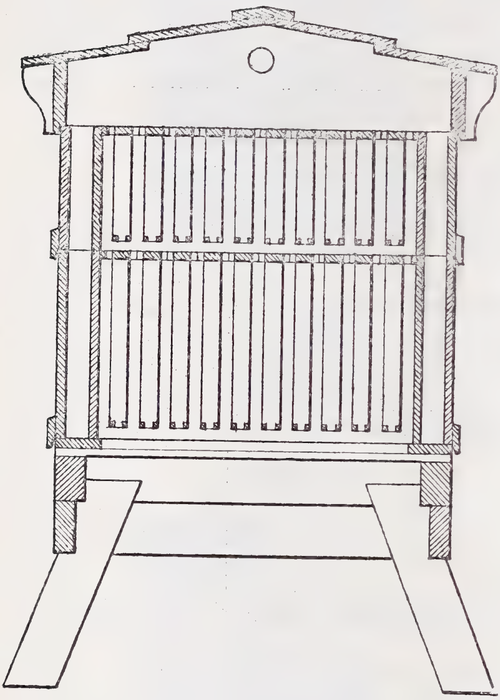


It will be well now to consider in detail the construction of a modern hive, and we will take as our type the W.B.C. hive invented by Mr. W. B. Carr, editor of the *British Bee Journal*, and probably the most widely used

of any kind of hive. A section through the hive from front to back is shown in Fig. 5, and a transverse section in Fig. 6.

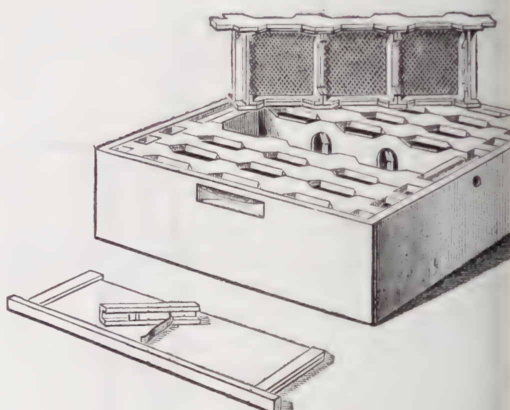
The lower part of the hive, the stand and floor-board, may be separated or joined together in one piece; but it is an advantage, as regards cleanliness, to be able to separate them. However well a floor-board may be constructed in the first instance, cracks are sure to appear in time and harbour moths and other insect enemies to the bees. I have covered the floor-boards of my hives

FIG. 6.



with linoleum for many years with excellent results, and a great saving of time when cleaning the hives. The alighting-board in front of the hive should be slanting, so that rain may run off rapidly, and in windy or exposed districts it is said to be an advantage to have the surface corrugated so that the bees may run up into the hive in the depressions. As regards size, opinions differ very widely. Some prefer large boards reaching down to the ground, others a width of a few inches only. In Germany the bees work very well with a narrow ledge of one or two inches, and wild bees will, of course, thrive without any alighting-board at all. In our climate a porch over at least a portion of the entrance is useful. Above the floor-board comes the brood chamber or body-box. In the hive illustrated the walls are hollow, necessitating an inner and outer casing; but cheaper forms of the same hive are made with single walls. Whatever the make of hive, the inner chamber must be made of such dimensions as to take the standard frame of the British Bee-keepers' Association. If extracted or liquid honey be required, a shallow frame box is placed upon the brood chamber, and upon this the roof. In an abundant honey flow, several such boxes may be used. All the frames should first be fitted with sheets of wax foundation, and to strengthen this and prevent fracture during extraction, fine wires are pressed into the wax. The distance between the combs is regulated by "metal ends," which are slipped on to the

FIG. 7.



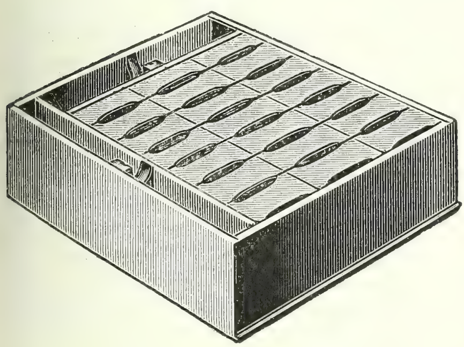
projecting ends of the frames. The W.B.C. metal end is light, easily fixed and removed, and is now in general use. Should comb-honey or, as it is tersely called, "sections," be desired, some form of section rack or crate, must be used. For the best work, especially for exhibition purposes, nothing can beat Mr. Carr's rack, which is shown in Fig. 7.

The sections are fixed in frames, which are then suspended in the hive in the same way as the shallow frames. A simpler form of section rack is shown in Fig. 8.

As made by Messrs. J. Lee and Son, this rack is provided with two loose side-boards pushed against the sections by springs, by which means the sections are kept in position, and the bees prevented from propolising between them. In all cases the faces of sections should be separated by "dividers," which are thin strips of material that compel

the bees to build the faces of the combs straight. Slips of metal are frequently used for this purpose, but are not to be recommended, on account of the chilling effect which they have upon the bees. The sections themselves are thin boxes without top or bottom with pieces cut out on two or more sides to afford a passage for the bees or a "bee-way," as it is termed. These sections are all imported from America in the flat, and are folded by the bee-keeper as required. In order to ensure accuracy in the building of the comb, either sheets of thin foundation or small triangular pieces of foundation, known as "starters" are fixed in the section before it is placed in position. When filled, a section $4\frac{1}{4}$ inches by $4\frac{1}{4}$ inches by 2 inches will contain more than a pound of honey-comb. These are the dimen-

Fig. 8.



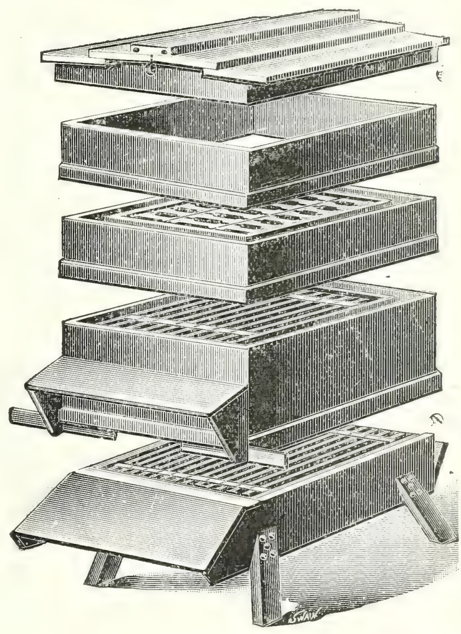
sions generally in use, but other sizes are being tried and appear occasionally at shows. Upon the upper layer in the hive, whether frames or sections, a "quilt" is laid, and upon this blankets or other warm covering. The French, Americans, and Germans use wooden coverings, and these certainly possess some advantages over our quilts, provided a bee-way be left above the frames.

Among the precursors of the W.B.C. hive may be mentioned the Cheshire and the Cowan hives, the latter being still largely used.

A recent hive, to which a number of prizes have been awarded, is E. H. Taylor's 20th Century Hive shown in Fig. 9. The chief point in which this differs from the previous constructions mentioned is the "swarming chamber" placed under the body-box. This, no doubt, prevents swarming in many cases, but in some seasons the bees swarm persistently in spite of there being plenty of vacant space in their hive. The bee-master who keeps his bees in "bar-frame" hives has many means of combating swarming, but the "skeppist" is comparatively helpless. In the height of the season a good queen will lay 2,000 to 3,000 eggs a day, and it may readily be imagined that an ordinary straw skep soon becomes insufficient for the needs of its teeming population. The bees, not having sufficient room inside, hang out at night, and, on the first favourable opportunity, swarm.

American and French bee-keepers use bar-frame hives very similar to our own, which are also rapidly being adopted in Switzerland. The hive which is most in favour in France at present is probably the Dadant-Blatt. The

Fig. 9.



German hives are closed on the top and the combs are manipulated by means of special tongs from the back or side. To us the system appears complicated, and the single advantage these hives possess is the possibility of placing them one above another in a bee-house.

As there are still a large number of skeps in country districts whose owners cannot be persuaded to abandon their ancient methods, it has become a matter of importance to devise means by which the best results can be obtained with a minimum waste of bee life. If the skep be properly constructed with a flat top and a hole in the centre it can be adapted for sections, and a moderate quantity of comb honey obtained in this form. The yield can,

however, never be as high as from a bar-frame hive. The chief objection to the skep system is, however, the cruel treatment of the bees at the time of the honey harvest. It was, and unfortunately still is, in some parts of the country, the custom to choose the heaviest skeps and place them over burning sulphur, the fumes of which soon kill the bees. The honey thus obtained was contaminated by the fumes of the sulphur, and the dead bodies of the bees and their brood, and the selection of the heaviest skeps was the surest means of deteriorating the strain of bees by selecting the least fit to propagate the race. The British Bee-keepers' Association has been specially active in promoting a knowledge of the more humane method of "driving" by which the bees are driven alive from the skep, and can then be placed in another hive and kept through the winter. The operation of driving is a simple one, and is frequently shown at flower shows, and on similar occasions. It consists in intimidating the bees by means of smoke and continuous tapping on the side of the skep, until they are compelled to run into an empty skep fixed above the full one. Providing the queen be secured, there is no difficulty in transferring bees in this manner. It will be observed that even the up-to-date bee-master uses a skep, but only as a temporary receptacle for the bees, until he can place them in a bar-frame hive. The old art of the skep maker is, therefore, not likely to become extinct, although it cannot be said to thrive at present. It has been objected to the modern hive that, although it may be neat, it is not picturesque, and I know bee-keepers who retain skeps simply because they have a more rustic appearance. Well-kept skeps look fairly well; even when not in their prime there is a certain air of rusticity about them, and when quite neglected, they become positively picturesque. But there is a serious aspect to these old, rotten skeps. Not only do they produce little, if any, honey; but they become the lurking place of the worst enemy of the bee-keeper, namely, foul brood. Formerly this disease was a serious obstacle to bee-keeping, and may even now cause heavy losses to individuals; but, since its nature has been recognised and means found to cure it, there is no longer the same reason to dread it as formerly. In Surrey, for instance, a few years ago, foul brood was rampant; but the Surrey Bee-keepers' Association, assisted by the excellent instruction given with the help of the Surrey County Council, have succeeded in reducing the percentage of cases to such an extent that I have recently had difficulty in securing a specimen of infected comb for research purposes. If bee-keepers would but co-operate and secure the services of efficient experts they need not fear foul brood. Another bee enemy, the wax moth, can only assume serious proportions in neglected apiaries. If hives be left too long unexamined, the combs may be utterly destroyed by this parasite. Sometimes the bee-keeper may suffer loss from circumstances beyond his control, for instance, a horse may upset a hive, and be injured by stings. To meet such cases the British Bee-keepers' Association has recently started an insurance scheme by means of which an insurance can be effected for the moderate amount of 1d. per hive per annum. Mr. T. I. Weston, the vice-chairman of the Association, informs me that the number of insurers is already 636, and hives insured, 7,342; being an average of about $11\frac{1}{2}$ hives per apiary. In many counties there are associations which promote apiculture by means of shows, expert visits, and the distribution of periodicals. The bee-tent of the County Association is a familar sight at flower shows and agricultural exhibitions, and sometimes the expert will initiate the more daring members of his audience into the mysteries of the hives themselves. The result of this propaganda is a regular increase in the number of bee-keepers; but still there are not enough. We are importing large quantities of so-called honey from abroad, while every year thousands of tons of excellent honey are wasted in our country districts for want of the bees to gather it. There can be no doubt that bee-keeping in most rural districts is remunerative. One of the apiaries of which you will presently see a view was started in 1894 by two factory workmen, who bought a skep of bees on joint account. They have now 24 stocks, which yield on an average 56 lb. of honey per hive.

But there is a larger and more important question connected with bee-keeping, namely, the fertilisation of blossoms and the production of fruit and seed. A large grower of bush fruit in Huntingdonshire established an apiary in his grounds, and at once found that his produce increased more than fourfold. As he now sends off six to ten tons of gooseberries per week during the season, the money value of his bees is not to be estimated by the yield of honey alone, although this also is considerable.

It has been found that some of our most highly-cultivated fruits are not self-fertile, that

is, the blossoms on a tree will not fertilise each other, but must receive pollen from another tree before they can bear fruit. This is the cause of the absence of fruit on many trees that blossom luxuriantly, especially when planted singly in small gardens. What agent more suitable than a bee can be found to bring the golden dust upon which the future crop depends ?

From an educational point of view, the value of the bee is undoubted. For countless ages it has been held up as a pattern of industry, and although many of the poetical fictions of our forefathers have melted away in the light of modern research, yet new facts have been discovered, and the bee, take her how you will, is always interesting to the student.

As regards the yield to be obtained from modern hives, the *British Bee Journal* has for some years been publishing data from numerous apiaries throughout the country. Through the courtesy of the editors, Mr. T. W. Cowan and Mr. W. B. Carr, I am able to show you views of some of these apiaries, and to give some of the figures.

DISCUSSION.

The CHAIRMAN, in opening the discussion, thanked the Council of the Society for giving the author an opportunity of dealing with such an important question as the industry of bee-keeping throughout the kingdom. Though the subject was utilitarian, it was intensely interesting and instructive, conveying information of practical value, and also teaching lessons of the highest moment. The author had explained the superior methods of what was called modern bee-keeping as compared with the old-fashioned methods which had maintained their hold until comparatively recent days. The bee had always been the model or emblem of industry, and the old-fashioned skep would, in spite of the non-sentimental modern creation of the bar-frame hive, which had the advantage of holding more honey, live in days to come as it had done in the past. The difference between the old-fashioned methods which had obtained for centuries and the modern methods was that in the former everything depended on the activity of the bee under natural conditions, whereas in the latter case it could be best described as the activity of the bee plus the activity of man. By the modern methods the produce was increased by an average of something like four-fold, Among the numerous references made by prominent people from the time of Virgil in regard to bee-keeping none was more remarkable than those in Shakespeare. Shakespeare's references to the bee were frequent, but the passage in "Henry V." was the most forcible :—

> "For so work the honey bees;
> Creatures, that, by a rule in nature, teach
> The act of order to a peopled kingdom.
> They have a king, and officers of sorts."

In addition to the practical value of obtaining four or five-fold more produce from the hive than under natural conditions, there was a profound depth of instruction in the subject, because of the economy in a hive of bees. The subject was a most fascinating one, and those who entered upon it would find it embraced an illimitable field. It would be found, with bees, as with men, that they required plenty of scope. Once the scope of the bees was curtailed, the queen having no room to lay, and the bees no place to store their honey, instead of being industrious they would be idle. Emerson had said, "All the uses of nature admit of being summed up in one use, which yields the activity of man an infinite scope." When bees, like human beings, became scopeless they became purposeless. An important point was that modern bee-keeping prevented the slaughter of the bees, and therefore the British Bee-keepers' Association had the approval of the Royal Society for the Prevention of Cruelty to Animals. The Bee-keepers' Association was a national institution, doing national work, in educating, examining, and generally representing the industry. In his opinion, if there were sufficient bee-keepers, it would be quite possible to produce a ton of honey in every rural parish in the United Kingdom, but at present the bee-keepers were not there. It must also be remembered that the quality and quantity of the honey varied according to the quality and quantity of the bee pasture. Many endeavours had been made to keep the agricultural labourer on the land, but it was unreasonable to expect him to remain unless he was given adequate wages. A labourer could add to his wages £2 per hive per year, and in that manner the difficult social problem of the agricultural labourer might be solved. A very important point was that the more bees there were, the more seeds, and the more seeds the more fruit, the bees quickly fertilising the fruit. Where gooseberries were in proximity to a hive of bees, they were early fertilised, and did not suffer from frost to the same extent that other gooseberries which were not fertilised did.

Dr. DIVERS mentioned that, in Japan, a country in which he had lived for some time, the honey of the wild bee was poisonous. It was utterly unlike the honey produced in the country; it was somewhat offensive in smell, black in colour, of a very thick consistence, and exceedingly bitter and nauseous to taste. On the other hand, the bees were very gentle creatures, and, so far as he could ascertain, no bee in Japan had ever been known to sting anybody. He believed the Japanese bees were stingless bees.

Mr. W. H. CARR expressed the pleasure with which he had listened to Mr. Reid's interesting paper.

Mr. SAMUEL HALL stated that on one occasion, when going down the Rhone, he saw a big barge, with many hundreds of hives of bees on board, moored at a particular place, and when that neighbourhood was exhausted, the barge went further down the river in order to get fresh pasture for the bees.

The CHAIRMAN believed the same practice was adopted on the Nile. It gave the bees a variety of pasture, and increased the area from which they could obtain their honey.

Mr. REID, in reply, thought Dr. Divers's remarks were extremely interesting, because it was quite possible that some kind of foreign bees might be crossed with the English, and thereby produce a greater gentleness, although he did not think the native English bee was at all savage, and could be easily managed. The cross-bred bees were certainly wild, and sometimes stung the bee-farmer very badly, but it was a consolation that one became inoculated against stings, and, after receiving a few at the beginning of a season, was immune for the remainder of the season. The removal of the hives up and down the rivers, had, so far as was known, been the practice from time immemorial in Egypt. The Egyptian hives consisted of pieces of earthenware tubes, the honey being collected alternately, from one end and then the other. By taking the hives up and down the river, the people were able to collect honey for six extra weeks. With regard to the influence of bees and the fertilisation of fruit, he had a most important illustration of the fact during the recent frost. He found in his garden that the gooseberries had been fertilised before the frost by the bees, which were immediately adjoining the bushes, whereas some of his neighbours less than a quarter of a mile off lost all their gooseberry blossom because it was not fertilised.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Reid for his interesting paper.

Miscellaneous.

*PUBLIC INSTRUCTION IN NEW SOUTH WALES.**

In no part of the Australian Commonwealth has the work of public instruction made such rapid progress as in New South Wales, where the existing system dates from 1880, when it replaced a somewhat chaotic condition of affairs occasioned by imperfect legislation. Under the new order of things, provision was made for the establishment and maintenance of public schools to afford primary instruction to all children without sectarian or class distinction; of superior public schools, in which additional lessons in the higher branches might be given; of evening public schools with the object of instructing persons who had not received the advantages of primary education while of school age; and of high schools for boys and girls in which the course of instruction should be of such a character as to complete the public school curriculum, or to prepare students for the university. It was provided that in all schools administered under the Act the teaching should be strictly non-sectarian; but the words "secular instruction" were held to include general religious teaching, as distinguished from dogmatical or polemical theology. The history of England and of Australia, it was decided, should form part of the course of secular instruction. Four hours during each school day were to be devoted to secular instruction exclusively; but it was provided that another hour each day might be set apart for religious instruction, to be given in a separate class-room, by a clergyman or religious teacher of any persuasion, to children of the same persuasion whose parents had no objection to their receiving such religious instruction. The provision permitting religious instruction to be given to scholars in State schools, says Mr. Coghlan, the New South Wales Government Statistician, has been taken advantage of to some extent by several of the denominations. Ten salaried teachers are employed by the Church of England in the Diocese of Sydney to give special religious instruction in public schools. One of the Bishop's chaplains holds the appointment of Diocesan Inspector of Schools, but he has no authority outside the classes for special religious instruction. The Presbyterian and Wesleyan clergy also visit the public schools for the purpose of imparting religious instruction to children belonging to those denominations. It is compulsory for parents to send their children between the ages of 6 and 14 years to school for at least seventy days in each half-year, unless just cause of exemption can be shown. Penalties are provided by the Act for breaches of this provision. But although education is compulsory, it is not altogether free, for parents are required to pay a weekly fee of 3d. per child, but not exceeding 1s. in all for the children of one family. Power is given, however, to the Minister, and to the Local Board, subject to ministerial approval, to remit the fees where it is shown that the parents are unable to pay. The fees, except those received from pupils attending evening schools, are not the property of the teacher, but are paid into the Consolidated Revenue Fund. School children are allowed to travel free by rail to the nearest public or private primary school; to the nearest superior public school, provided they are sufficiently advanced to be enrolled in the fifth class; and to the High Schools. Other sections of the Act permit of the establishment of provisional schools, and the appointment of itinerant

* Communicated by Mr. John Plummer, Sydney, Australia.

teachers in remote and thinly-populated districts. Provision is also made for the establishment of training schools for teachers. It is enacted that Local Boards shall be appointed, whose duty it is to visit and inspect the public schools placed under their supervision, to suspend teachers in cases of misconduct not admitting of delay, to endeavour to induce parents to send their children regularly to school, and to report the names of parents or guardians who refuse or fail to educate their children. It should be observed that parents are not compelled to send their children to the public schools; they have full choice in the matter, the State only insisting that a certain standard of education shall be attained, no matter whether the instruction be imparted in public or private schools. At the close of 1900 there were in the State 5,666 schools, with an enrolment of 300,837 children, representing over 22 per cent. of the whole population.

THE WORLD'S COAL PRODUCTION.

The rapidity with which the production of coal has increased may be appreciated when the present volume of that production is considered, in conjunction with the phenomenal increase in output within recent years. In 1864 the world's produce of coal was 171,000,000 tons; in 1883 it was 444,000,000, and in 1901, 773,000,000 tons, according to the Bureau of Statistics of Washington. The statistics of production for earlier periods cannot be determined with any degree of precision, but on the basis of the British statistics subsequent to 1854, and of estimates for earlier periods, and from such statistics as are obtainable from France, Germany, Belgium, and Austria-Hungary, an approximation may be made of the actual production. In 1860 the world's production of coal was about 141,000,000 tons, or less than one-fifth of the production of 1901, and considerably less than the output of the United Kingdom or the United States at present. Ten years earlier the world's production amounted to only about 83,000,000 tons, about one tenth of the present production. In 1840, the production was much smaller still, amounting to little over 40,000,000, while during the three-quarters of a century, since 1820, when the output was about 17,000,000 tons, the production has increased in enormous proportions. While the figures of the world's production prior to 1864 are necessarily defective, owing to the absence of accurate statistics, they indicate sufficiently the immense development of the industry during the last century. The production of coal is chiefly in the hands of three nations—the British, American, and German. During the last thirty years, and even before, the combined coal output of the United States, the United Kingdom, and Germany, has averaged year for year, about five-sixths of the coal output of the world. Possessing only a tenth of the world's population, they have produced about 83 per cent. of the mineral fuel, while the remaining 90 per cent. of the world's inhabitants have produced only about 17 per cent. of the coal, and even if the savage and semi-barbarous nations be disregarded, the immense preponderance of coal production in these countries must be conceded. To this group might be added Belgium, which produces and consumes more coal per capital than any other European country except the United Kingdom, but the fact of its small population places it in the second rank of coal-producing countries. While the continued output of these three countries has kept pace with the production of the rest of the world, their relative position has been materially altered. In 1868 the United Kingdom produced over three times as much as either the United States or Germany, the output of these countries being approximately 52, 14·5, and 16·5 per cent. of the world's production. In 1870 the proportion was about the same, although the United States had gained upon Germany as a coal producer. By 1875, the output of the United Kingdom was still considerably greater than the combined production of the United States and Germany, the output of these three countries being 45, 20, and 18 per cent. of the world's production respectively. The next half decennial period witnessed a remarkable increase in the American production and a corresponding relative decrease in that of Great Britain, the proportions of the three countries under consideration being 36, 28, and 17 per cent. respectively. This increase was maintained during the latter part of the past century, and in 1896 the output of Great Britain and Ireland was only 34 per cent., that of the United States already 30 per cent., and that of Germany 19·2 per cent. of the coal production of the world. In 1899 for the first time, the coal production of the United States exceeded in quantity that of Great Britain. This superiority was maintained for two successive years. During 1901, the United States production was greater than the amount of coal produced in Great Britain and all her colonies. During that year the shares of the leading coal-producing countries were as follows:—United States, 34 per cent.; United Kingdom, 28 per cent.; and Germany, 19·2 per cent.

Obituary.

Mr. HORACE BELL, M.Inst.C.E., whose death occurred on the 10th inst., was a leading member of the Department of Public Works in India. Mr. Bell's official career lasted 32 years, and throughout practically the whole of that time he was engaged either in the construction or administration of railways. When he entered the service in 1862, during the Viceroyalty of the eighth Earl of Elgin, the Public Works Department was in its infancy, and India possessed no more than 2,333 miles of railway communication. When Mr. Bell retired during

the Viceroyalty of the ninth Earl of Elgin, the length of the Indian lines was 18,906 miles; since increased to about 26,500 miles. After doing good work in various executive capacities, and rising to the post of Chief Engineer, Mr. Bell was eventually selected for the important position of Consulting Engineer for Railways to the Supreme Government. He also officiated as Director-General for Railways. He returned to England in 1894. He subsequently (in the year 1898) joined the Society, and as a member of the Indian Committee took an active part in the work of the Indian Section. He contributed two papers—"Railway Policy in India" (April, 1898), and "Railways and Famine" (February, 1901)—and was collecting material for a third on the need for more ports in India. He was the author of two works, one entitled "Laws of Wealth," and the other on Indian railway policy.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evening, at Eight o'clock:—

April 29.—"Automatic Wagon Couplings on British Railways." By T. A. Brockelbank.

May 6.—"The Construction of Maps and Charts." By G. J. Morrison. Sir William Wharton, K.C.B., Hydrographer to the Navy, will preside.

May 13.—"Preservation of Big Game in Africa." By E. North Buxton. Sir John Kirk, G.C.M.G., K.C.B., will preside.

May 20.—"Fencing as an Art and an Historic Sport." By Egerton Castle, M.A.

Indian Section.

Thursday Afternoon, at 4.30 o'clock:—

May 14.—"The Province of Assam." By Sir Charles James Lyall, K.C.S.I., M.A., LL.D. The Right Hon. Lord George Hamilton, G.C.S.I., M.P., will preside.

Colonial Section.

Tuesday Afternoon, at 4.30 o'clock:—

May 5, at 4.30 p m.—"The Lagos Hinterland: its People and its Products." By Major J. H. Ewart. Sir John Smalman Smith, M.A., will preside.

Applied Art Section.

Tuesdays:—

April 28, 7.30 p.m.—Visit to the Whitefriars Glass Works. Paper by Mr. Harry Powell on "Modern Table Glass." (Special tickets required.)

May 19, 4.30 p.m.—"Mezzotints." By Cyril Davenport, F.S.A.

Cantor Lectures.

Monday Evenings, at Eight o'clock:—

W. Worby Beaumont, Mem.Inst.C.E., "Mechanical Road Vehicles." Four Lectures.

Lecture I. — April 27. — Introduction—The Cantor Lectures of 1895—The industry in 1895—The 1896 Light Locomotives Act—Speed limits and technical details thereof—Petroleum spirit regulations—Recognition of the importance of the petrol motor—The industry in 1896—The Crystal Palace Show—The Commemoration run to Brighton—Outline of achievements since 1896.

MEETINGS FOR THE ENSUING WEEK.

Monday, April 27...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. W. Worby Beaumont, "Mechanical Road Vehicles." (Lecture I.)
Geographical, University of London, Burlington-gardens, W., 8½ p.m.
Actuaries, Staples-inn Hall, Holborn, 5 p.m.
Medical, 11, Chandos-street, W., 8½ p.m.

Tuesday, April 28...SOCIETY OF ARTS. (Applied Art Section.) Visit to the Whitefriars Glass Works. Mr. Harry Powell, "Modern Table Glass."
Royal Institution, Albemarle-street, W., 5 p.m. Prof. A. Macfadyen, "The Blood and some of its Problems." (Lecture II.)
Medical and Chirurgical, 20, Hanover-sq., W., 8½ pm.
Civil Engineers, 25, Great George-street, S.W. 8 p.m. Annual Meeting.
Photographic, 66, Russell-square, W.C., 8 p.m.

Wednesday, April 29...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. T. A. Brockelbank, "Automatic Wagon Couplings on British Railways."
Geological, Burlington-house, W., 8 p.m.
National Indian Association, Jehanghir Hall, Imperial Institute-road, S.W., 4½ p.m. Annual Meeting.
Royal Society of Literature, 20, Hanover-square, W., 4½ p.m. Annual Meeting.
British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.
Zoological, 3, Hanover-square, W., 4 p.m. Annual Meeting.

Thursday, April 30...Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Royal Institution, Albemarle-street, W., 5 p.m. Prof. Dewar, "Hydrogen—Gaseous, Liquid, and Solid." (Lecture II.)
Electrical Engineers, 25, Great George-street, S.W. 8 p.m. Mr. W. Aitken, "Divided Multiple Switch-boards: An Efficient Telephone System for the World's Capitals."

Friday, May 1...Royal Institution, Albemarle-street, W., 5 p.m, Annual Meeting. 9 p.m. Prof. W. J. Pope, "Recent Advances in Stereo-Chemistry."
Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper on "Art Bronzes."
Geologists' Association, University College, W.C., 8 p.m.
Philological, University College, W.C., 8 p.m. Annual Meeting.
Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Saturday, May 2...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Langton Douglas, "The Early Art of Siena." (Lecture II.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

MONDAY, MAY 4, 8 p.m. (Cantor Lecture.) W. WORBY BEAUMONT, M.Inst.C.E., "Mechanical Road Vehicles." (Lecture II.)

TUESDAY, MAY 5, 4.30 p.m. (Colonial Section.) MAJOR J. H. EWART, "The Lagos Hinterland: its People and its Products."

WEDNESDAY, MAY 6, 8 p.m. (Ordinary Meeting.) G. J. MORRISON, "The Construction of Maps and Charts."

Further details of the Society's meetings will be found at the end of this number.

PRIZE FOR A DUST-ARRESTING RESPIRATOR.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Prize of a Gold Medal, or Twenty Pounds, for the best Dust-Arresting Respirator for use in dusty processes, and in dangerous trades.

The Council are well aware that for many years past the necessity for such an apparatus has been recognised. As far back as 1822 the Society awarded its Gold Medal to Mr. J. H. Abraham, of Sheffield, for a Magnetic Guard to protect persons employed in dry grinding. The apparatus described in the Society's "Transactions" (Vol. 40, 1822, page 135) includes a Respirator to cover the mouth and nose. This Respirator was fitted with magnets, for the purpose of arresting the fine particles of steel thrown off in the process of pointing needles, and in other processes of dry grinding. Although the invention was greatly appreciated at the time, it appears never to have come into practical use, the main objection to it having been, it is believed, raised by the workpeople themselves, who feared that the lessened risk attached to their employment would lower their wages. Similar considerations have, it is believed, stood in the way of the introduction of various appliances intended to limit the risks associated with all trades in which the workpeople breathe a dusty atmosphere. The Council, however, think that such considerations are likely to have less weight at the present time, and they hope that the offer of a prize may draw the attention of inventors to the matter, so that it may result in the production of some suitable piece of apparatus, despite the difficulties with which the solution of the problem is surrounded.

The apparatus will be required to fulfil the following conditions:

(1.) It must be light and simple in construction.

(2.) It should be inexpensive, so as to admit of frequent renewal of the filtering medium or of the Respirator as a whole; or alternatively it should be of such construction that it can be readily cleaned.

(3.) It should allow no air to enter by the nostrils or mouth except through the filtering medium.

(4.) It should not permit expired air to be rebreathed.

(5.) The filtering medium, though it should be effective in arresting dust particles, should not offer such resistance as to impede respiration when worn for some hours under the actual conditions of work.

(6.) It is desirable that it should be as little unsightly as possible.

It should be noted that the prize is offered for a Respirator intended merely to arrest dust, and not for a chemical Respirator designed to arrest poisonous fumes. The applications of such chemical Respirators are more limited, and there are special requirements connected with them. The Council have, therefore, preferred to limit the range of their present offer to the simpler and more important cases of dust, either dust of all kinds or of some special character, *e.g.*, iron or steel.

Inventors intending to compete should send in specimens of their inventions not later than 31st December, 1903, to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C. Such specimens must be accompanied by full descriptions, and in cases in which the apparatus has been put into actual use, the experience of such use should be given.

Competitors intending to patent their inventions should be careful to obtain protection, as the Council of the Society cannot undertake any responsibility as regards the secrecy of the whole, or of any part, of an invention submitted to them.

The Prize will be awarded on the report of judges appointed by the Council.

The Competition is not limited to British subjects.

The Council reserve to themselves the right of withholding the Prize, of extending the time for sending in, or of awarding a smaller Prize or smaller Prizes.

CANTOR LECTURES.

Mr. W. Worby Beaumont, M.Inst.C E., delivered the first lecture of his course on "Mechanical Road Vehicles," on Monday evening, 27th April.

These lectures will be printed in the *Journal* during the autumn recess.

APPLIED ART SECTION.

The visit of the members of the Society of Arts to the Whitefriars Glass Works, on the invitation of Messrs. James Powell and Sons, took place on Tuesday evening, April 28th, from 7.30 to 10 p.m. A paper, "On Table Glass," was read by Mr. Harry Powell, after which the company inspected the show-rooms.

The glass exhibited in the various show-rooms included the following:—Coloured table glass: cartoons for stained glass, by Sir E. Burne-Jones, Sir E. Poynter, Ford-Maddox-Brown, W. Morris. Specimens of mosaic designed by Sir W. B. Richmond, R.A. Vases, &c.; electric light fittings; cut and engraved glass from old models; modern cut glass; modern engraved glass. Glasses copied from old pictures: The "Knossos" Jar, the Colchester Roman Vase, the Puzzle Bottle. Modern blown table-glass, silver work: Thermometer tubing, museum jars. Opaque glass: Tiles (plain and stencilled), coloured enamels, and gold used for mosaic, mother-of-pearl, specimens of opus sectile, &c.

The visitors then proceeded to the Glass-houses, and were shown the various processes of ornamental glass manufacture in actual operation. The following operations in glass-blowing were shown:—(*a*) Tube drawing, (*b*) Threaded bottles, (*c*) Vases with "tears," (*d*), Museum jars, (*e*) Large vases.

The hearty thanks of the company were expressed to Messrs. James Powell and Sons for the interesting exhibition which had kindly been placed before them.

The paper read by Mr. Harry Powell will be printed in a future number of the *Journal*.

Proceedings of the Society.

NINETEENTH ORDINARY MEETING.

Wednesday, April 29, 1903; the Hon. Richard Clere Parsons, M.A., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Hippisley, Colonel Richard Lionel, R.E., C.B., 39, Grosvenor-road, Westminster, S.W.
Hughes, H. G., 30, Bread-street, E.C.
Kinley, Prof. David, Ph.D., University of Illinois, Urbana, Illinois, U.S.A.
Leslie, Thomas Nicholas, F.G.S., P.O. Box, 23, Vereeniging, Transvaal, South Africa.
Power, Frederick Belding, Ph.D., 6, King-street, Snow-hill, E.C.
Price, Matthew Burn, F.R.I.B.A., 254, Longmarket-street, Pietermaritzburg, Natal, South Africa.
Reynolds, H. H., M.I.E.E., 4, Fairlie-place, Calcutta, India.
Spier, William, Mansfield-chambers, Quay-street, Rockhampton, Queensland, Australia.
Rose, George B., Messrs. Rose, Hemingway and Rose, Little Rock, Arkansas, U.S.A.
Rose, George Edwin James, Messrs. Butterfield and Swire, Wuhu, China.

The following candidates were ballotted for and duly elected members of the Society:—

Bridgewater, Francis Matthew, 72, Coleman-street, E.C., and Terriers House, High Wycombe, Bucks.
Cromer, Earl of, P.C., G.C.B., G.C.M.G., K.C.S.I., C.I.E., British Agency, Cairo, Egypt.
Deeble, William Rufus, M.I.Mech.E., Chief Mechanical Engineer's Office, Tasmanian Government Railways, Launceston, Tasmania.
Fenix, George, Cala, Cape Colony, South Africa.
Fulton, Dr. Robert, M.B., Dunedin, New Zealand.
Lang, Sir R. Hamilton, K.C.M.G., The Grove, Dedham, Essex.
Langman, John Lawrence, 6, Stanhope-terrace, Hyde-park, W.
Lyons, Frank J., Penlee, West End-lane, N.W.
Mansfield, Richard, 316, Riverside Drive, New York, U.S.A.
Shadwell, Lancelot Horace Augustus, A.M.I. Mech.E., Engineers' Offices, Natal Harbour Department, Durban, Natal, South Africa.

Welsh, Charles, Winthrop, Highlands, Massachusetts, U.S.A.

Wingate, F. Melson, 103, Tavistock-road, Plymouth.

The paper read was—

AUTOMATIC COUPLERS ON BRITISH RAILWAYS.

By T. A. Brockelbank.

The man who addresses you stood on this platform twenty-seven years ago discussing the very question which brings us here. So little was known thereon in 1876 that your late Secretary, Mr. Le Neve Foster, expressed doubt as to whether the subject of fastening railway wagons together could possibly be of any interest to your Society. He was, however, converted and on that occasion Mr. William Galt, then member of the Royal Commission on the Safety of Railway Passengers, presided over a full house of members of this Society, Board of Trade officials, railway engineers and railway officials, railway wagon builders, representatives of railway servants and others.

In 1874 it was estimated that 20,000 railway servants were annually killed and injured on British railways in and about their work; the railways themselves understood little about the true conditions under which they occurred, they just happened as a matter of course in the ordinary way of business. Even accidents to passengers were then contemplated by some railways as the inherent risks of railway traffic.

Certain members of Parliament, however, took a different view of the slaughter of railway servants, and the *Times* spoke out straight on the subject in 1873, but nothing was done; the immense Parliamentary power of the railways throttled Governments, and for twenty-five years longer successfully resisted the efforts of Presidents of the Board of Trade, including such strong men as Mr. Joseph Chamberlain and Sir Michael Hicks Beach, Mr. Ritchie, and others. At last the Act of 1900 was passed placing in the hands of the Board of Trade the right to select safety appliances for the men's safety, but the railway interest still fights on.

In 1844, Mr. Gladstone startled the House of Commons by saying: "I would no more trust the railway proprietor on railway matters than I would the Gracchi speaking of Sedition." The situation is little better, sixty years later!

To-day automatic couplers in the United States are a world-renowned success. Automatic coupling on railways is now being considered or used in every quarter of the globe, on the continent of Europe, and even in colonies and dependencies of this Empire, but with the railways of the United Kingdom as a body their benefits and advantages remain an unknown, unsettled, and unsettling problem.

We are even surpassed upon this question of automatic couplers by the Republic of Mexico, where they are now compulsory, concerning which State the clerk of the British Legation says that whilst the volume of trade in Mexico annually *increases*, the share with the United Kingdom *always decreases*, because British manufacturers and merchants will not adopt more modern methods.

Let us therefore turn at once to the experiences of the United States railroads, where in the State of Massachusetts, sixteen years ago, automatic couplers were made compulsory, and where the United States Legislature passed a like compulsory Act in 1893 covering the entire system of the United States railroads.

United States Centre Buffer Couplers.

These centre buffer couplers we examine together a little later on, but the following figures show what has been done by their adoption in the United States, and what the position of the railways of the United Kingdom is concerning coupling accidents when contrasted with them:—

United States Couplers.

Under this 1893 Act of Congress, Automatic Centre Buffer Couplers were made compulsory and gradually applied to a railroad rolling stock numbering more than double the total number of vehicles that are owned by the whole of the British Railway Companies in this year of 1903.

	Number of men employed in coupling and uncoupling.	Killed.	Injured.	Reduction in accidents on the year 1893.	
					%
1893	197,636	433	11,277	—	—
1894	160,033	251	7,240	4,219	36
1895	157,731	291	8,137	3,282	28
1896	162,876	229	8,457	3,024	25
1897	161,397	214	6,283	5,113	44
1898	170,708	209	5,433	6,068	52
1899	178,851	196	5,281	6,233	53
1900	192,198	228	3,970	7,512	64
1901	209,043	198	2,768	8,743	75
1902	215,000*	143	2,113	9,454	80
		68 %	81 %	53,748 total reduction	

U.S.—1901 Record, 1 in 73 employed. Reduction 80 per cent.

British Railway Returns to Board of Trade.

The Shunting Pole in use.

	Number of Goods Guards and Shunters.	Killed.	Injured.	Increase on 1893.	Per cent.
1893	*17,000	11	286	—	—
1894	17,000	23	298	35	8
1895	17,000	16	331	50	17
1896	18,973	18	488	209	69
1897	18,973	19	492	214	71
1898	18,973	18	481	202	68
1899	23,964	16	567	286	95
1900	23,964	25	565	293	99
1901	26,549	14	571	288	100
1902	27,000*	Estima	te only.	290*	—
				2,069 increase	

British—1901 record, 1 in 45 employed.
Increase 100 per cent.

The United States Safety Appliance Law.

The sixteenth report of the Interstate Commerce Commission for 1902, says:—

"The gratifying results of the law of 1893, requiring the use of automatic car couplers and of power brakes, were spoken of in the fifteenth annual report. The benefits of the law have been increasingly evident during the past year. In particular, the number of persons killed and injured in coupling and uncoupling cars during the year ending June 30th, 1902—the first entire year reported since the law went into full effect—shows a diminution as compared with 1893, the year in which the law was passed, of 68 per cent. in the number killed, and 81 per cent. in the number injured.

* * * * *

"But casualties continue to occur, and their number is such as to call for continued and earnest efforts to eliminate their causes."

We are thus officially told that the United States are intent on beating their own splendid record of annually saving eight out of ten of the men they previously sacrificed in coupling and uncoupling railway wagons.

Within this very same period the British railway returns of coupling and uncoupling accidents made to the Board of Trade increased 100 per cent., and the contrast shown is strikingly suggestive as we inspect the figures.

English Railway Opinion.

On the 18th October, 1902, a report of the London and North-Western Railway contained the following strange opinion of the situation:—"It is perhaps only fair to state that the"—United States Railroad—"figures for 1901, which have recently come to hand, show a considerable reduction in the number of *employés* killed and injured in coupling and uncoupling," and the writer has the audacity to add this:—"American companies have nothing to boast of in the safety either of their passengers or of their *employés*. On the contrary, human life seems to be considered of much less importance over there than it does with us, and I am opinion that in this respect *British railway officials have nothing whatever to learn from their American confreres.*"

Transport, a newspaper friendly to railways, writing on the 27th February, 1901, remarks:—

"This railway prefers, or so it seems, to contemplate the difficulties of any innovation, rather than its advantages; it gives the impression of being always better up in the cons than in the pros; its brains and influence appear sometimes to be more earnestly engaged in discovering and creating obstacles to progress, than in removing them."

This candid opinion of a well known and friendly railway paper is noteworthy, and after 30 years' experience of this very same railway which has consistently denied me every opportunity to demonstrate the value of automatic coupling, it is indeed interesting to find an impartial journal so accurately defining the situation.

Let us look again at these figures and see whether "British railway officials have nothing whatever to learn from their American confreres."

The men engaged in this work in the United States number 209,000, and 1 in 73 are killed or injured at this work, while those so engaged in this country number but 27,000, with 1 in 45, and we see at once that in 1902 the record is against this country.

English Railway Servants' Dangers.

How many people realise that according to the railway companies' own returns to the Board of Trade, 150,000 railway *employés* are killed or injured in this land in ten years. This is equal to the population of any one of the following large towns: Leith, Sunderland, Halifax, Norwich, Derby, or Oldham.

Every day in the week, year in and year out, 42 railway *employés* are killed or injured. This is nearly at the rate of two every hour. One goods-guard or brakesman out of every 13 is killed or injured. Every

24 hours three are placed *hors de combat.* One shunter out of every 14 is stricken down every year. Every day two shunters have to pay the penalty of their dangerous calling. Every day two engine-drivers and three firemen are killed or injured. One driver out of every 18, and one fireman out of every 19, have to pay the inevitable penalty. One porter out of every 18 is killed or injured. Eight are sacrificed every 24 hours. One permanent-way man out of every 42 is killed or injured during the year. Four are thus disposed of every day.

And there are two distressing features which do not figure in Government returns. Nearly all the men killed on railways are married and leave families. This means that fully 5,000 widows and 15,000 children are robbed of their breadwinners every ten years, whilst a large proportion of those men returned as injured, either ultimately die from the injuries received, or find places on the operating table of a hospital as a result. But this is by no means the whole truth. The railway companies' own returns are what are published, and how far short they are of disclosing the true state of the case let their own evidence record.

Is the Full Truth Known?

The following question was put to the general manager of this same London and North-Western Railway at the Royal Commission of 1899:—

"*Question* 6351—Your accidents reported to the Board of Trade. 3,812 were over five hours. Now, for the year 1896, your insurance society paid for men injured on duty with an average of three weeks four days injuries in 7,223 cases out of 48,000. That is an enormous proportion is it not—one man in seven of 48,000 persons injured in one year?"

"*Answer*—It is a large proportion."

We have here accident insurance for a single year paid on 7,223 accidents by this same London and North-Western Railway, which reported to Parliament but 3,812 of them. I challenge that railway to find a single United States railroad which shows such an awful proportion as one in seven.

Let it not be supposed that I am here arguing that all these figures ought to have gone to the Board of Trade, for there is doubtless some rule or plan under which they are compiled. What I now contend for is this, that the truth, *the whole truth*, is not known and never has been known concerning these accidents or the real number of them, and if we look a little further we shall see my conclusions confirmed in a very remarkable manner.

Home Office Report.

A report was issued in January this year by a Departmental Committee appointed by the Home Secretary (Mr. Ritchie) in 1901. It declares that a comparison of fatal accidents reported from mines and quarries under the Factory Act is striking, and after an investigation into Miners' Relief Societies, and taking the numbers of members of six societies as a basis, it further says: that "if the Mines Act had required that every accident which caused a miner to be absent from his work for at least a week (which is a much longer period than that fixed in the Factory Act), should be reported, over 100,000 cases would have had to be reported" in the year 1900, "instead of the actual number, 5,431" which was reported, or more than 19 times over.

War Dangers.

It is a startling fact if the 448,435 British soldiers engaged in the late South African War, had been shunters occupied in that peaceful occupation instead as they were men engaged in killing with the risk of being themselves killed, then the 44,771 killed, wounded, and deaths by disease, which was the recorded total, would have risen in killed and wounded only to nearly 70,000. This is calculated only on the railway companies' own returns.

Money Saving and Railway Dividends.

Up to this point we have been discussing accidents which occur in coupling operations in the United States of America, and the wonderful reduction of them achieved by the adoption of automatic couplers, and what may be reasonably looked for in this direction in this country when it wakes up and follows suit. Has it paid the United States railroads thus to throw away three millions of couplers, some of them quite new, in order to adopt a single pattern automatic coupler?

About this there is no mistake, for even five years ago the president of one of the largest railroads in the States declared it had paid his railway handsomely to do so, whilst the Interstate Commerce Commission reporting in January, 1902, dwells especially on the time saved in despatching traffic owing to the extended use of automatic couplers and efficient brakes, and says that "railway officers have testified to a large saving of doing work

in yards," that "yards which in 1897 were taxed to their utmost capacity are now able without extension to accommodate greatly increased traffic." The cost of equipping these vehicles varied from £7 10s. to £3 12s. per vehicle, but taking the average at £5 10s., the expenditure of the United States railroads in this equipment with renewals since the Act of Congress was passed in 1893, must have far exceeded £9,000,000. Could those railways to-day magically revert to the conditions of but five years ago, their losses in working expenses alone would represent annually millions of dollars, whilst it would be simply impossible to despatch the traffic with the same speed and economy with which it it is being done to-day.

Railway Savings in the United Kingdom.

How stand the British Railways in contrast?

On the 16th September, 1901, the Lancashire and Yorkshire issued to its staff a card of injunctions—for officials to read, mark and inwardly digest, and put into practice—it was headed:—

"*Five Good Things to Do.*"

1. Save train miles.
2. Save wagon miles.
3. Save engine miles.
4. Load wagons to their full capacity and thus use fewer wagons.
5. Move loads and empty wagons promptly.

All these five make money, the unit of expenditure on a railway is the train, engine and wagon mile. Every mile saved is money saved, and determines the value to the Company of the services of those who institute the saving."

Signed General Manager.

September 16th, 1901.

This astute general manager is only enforcing what was declared from this platform by me in 1876.

In the United Kingdom to-day, there are somewhere about 15,000 stations, junctions, sidings, quarries and collieries. If in each 24 hours we can save one minute (on the average) by automatic couplings in these 15,000 stations, &c., then in twelve months a saving representing over ten years night and day would result, equal to one hundred years inside any ten years working on English railways.

Is this impossible or visionary? Let me give a few samples.

The Shunting Pole System.

Exceptionally expert and athletic shunters can to-day couple and uncouple, by shunting pole, 20 wagons in two minutes in daylight and under best conditions, but assuming we could eternally banish fog, frost, ice, snow, and rain, it is beyond human power to keep this up for even half-an-hour, whereas with automatic coupling something like this rate can be maintained day and night in all weathers and under all conditions in perfect safety to the workers.

Traffic Delays under the Shunting Pole System.

Let the following tell what such increased despatch and safety means. I timed one goods train four successive journeys; its timetable time was seven hours, including stoppages with shunting at intermediate stations and sidings. Its fastest journey took eight and a half hours, and the longest (through delays with trains in front of it and overtime expended in its own shunting operations) occupied 13 hours and 50 minutes—or as will be seen, just two hours for every one it should have taken, and every train behind it was more or less delayed thereby. On a small section of the Midland Railway not long since, eight goods trains lost between them 25 hours inside a given 48 hours.

This affects shareholders, investors, and traders. Delayed engines standing in steam cost nearly as much as when running. We have to bear in mind increased locomotive charges of all kinds, calculate waste in coal, additional wear and tear in many ways, we must estimate demurrage expenses, idle time of wagons, both belonging to the companies and to private owners, we must calculate overtime of engine drivers, stokers and shunters, and in some instances of signalmen and inspectors. When we come to the traders' side of the question, we are confronted with delayed deliveries of materials urgently needed for manufacture, entailing often heavy loss in manufacturers' charges. Millions are being lost by adhering to the present system, and the change from the shunting pole to automatic coupling will be found pecuniarily a more far reaching and valuable improvement than has ever yet been made on our railways of the United Kingdom.

My time is limited or I could enlarge on this point, but I am convinced that on some railways automatic couplings would be worth 2½d. per goods train mile run—to general managers, traffic managers, goods managers and line superintendents they would prove of great value.

About three years ago I had occasion to

interview the Assistant Traffic Manager of the London and North-Western Railway, and in the course of conversation I referred to the unpunctuality and consequent congestion of goods traffic. He assured me that except in the month of October, and perhaps February, they were compelled to shut their eyes to unpunctuality, it was simply impossible for their servants to keep to working time-table time with goods trains. I then asked whether he had ever contemplated the immense saving in time and money which automatic coupling would secure his Company. He admitted he had never given it a thought, being far too busy to do so.

Goods Wagons owned by Railways of the United Kingdom, 1880–1890–1900.*

	31st Dec. 1880.	31st Dec. 1890.	31st Dec. 1900.
1. London and North Western .. .	45,568	56,181	70,528
2. Lancashire & Yorkshire	18,534	21,154	28,770
3. Midland	32,334	98,668	118,626
4. Great Eastern ..	11,182	15,186	25,233
5. Great Northern ..	15,593	25,067	37,090
6. Great Western ..	33,940	43,584	58,878
7. Great Central.. ..	11,718	13,928	22,155
8. North Eastern ..	74,759	81,310	98,248
9. North Stafford ..	5,021	5,152	5,945
10. London Brighton ..	6,410	7,576	9,843
11. South Eastern and Chatham .. .	6,308	7,199	10,600
12. London and South Western	7,092	9,136	13,274
13. Furness	6,810	7,208	7,598
14. Caledonian	41,076	46,748	63,183
15. Glasgow and South Western	11,326	12,887	17,282
16. North British.. ..	26,187	45,368	62,708
	353,868	496,358	649,963
Other Railways .	18,486	21,663	51,399
	372,354	518,015	701,362

Increase in Wagon Stock 329,008, or an additional 98 per cent. in 20 years.

* Extracted from "The Railway News" Statistical Tables.

Cost of Alteration.

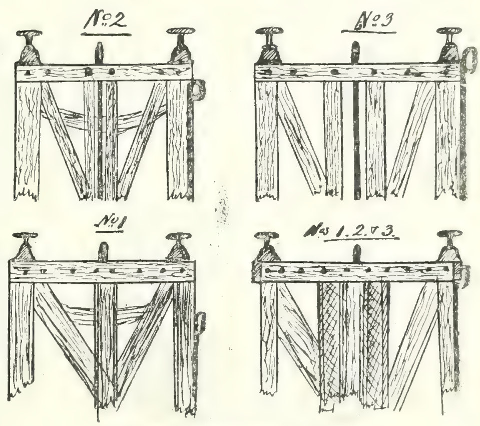
There is a very serious point for railway shareholders in this delay in adoption of automatic couplers in the United Kingdom, as the figures of the wagon stock of railways I now submit clearly indicate. Putting the cost of alteration at £5 per wagon, in 1880 all the goods wagons could have been so equipped for £1,861,770, by 1890 (ten years later) it had reached £2,590,071, by 1900 (another ten years) it rose to £3,506,810, and to-day it must reach £4,000,000 or about half a million more since the Act of 1900 was passed.

I commend this point to the careful consideration of all concerned, for automatic couplings have to come sooner or later.

English Railway Wagon Stock.

We now enter on the mechanical part of our subject, and in order to prepare you for the peculiarities and lack of unity prevailing on English railways, you should learn that only in this year of 1903, have all the railway companies fitted the headlights to their engines on the same spot on their engines, so at last, when an engine of another railway comes on to a given line, a signalman seeing a train approaching his box need have no doubts concerning the headlights approaching him.

Fig. 1.

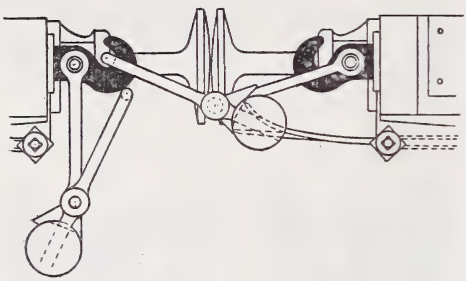


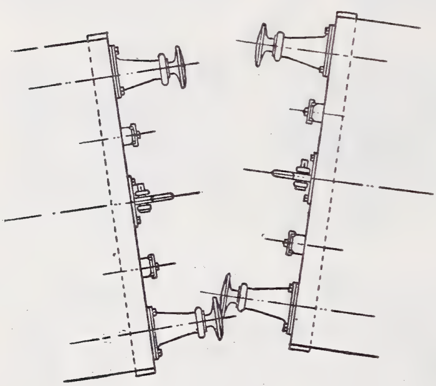
Types of Wagon Frames.

There still exists a charming variety of steps on the engines themselves, by which the engine driver mounts to or descends from his engine, and a man used to one plan may any day suddenly have another step at another angle and another height to confront. How many engine drivers and firemen have met their deaths or been injured for life, owing to such diversity, will never be known. With two such samples of railway unity before us, we need not be surprised to discover that variety in goods wagons is perfectly charming, though you will hardly be inclined to believe me when I tell you that in one lot of 3,000 wagons which came under my notice, I found, or had pointed out to me, 100 varieties in makes, shapes, or details in fittings.

One or two, as a sample of what an intricate problem automatic coupling inventors have had to confront will suffice. Here we see sections of underframes of wagons. An inventor who starts and fits his coupler invention on to two wagons of No. 1 type may find his apparatus on a straight line work well, but when he comes to No. 2 in which the timbers are set differently, the chances are he must alter the details of his apparatus or method of fixing, and when he gets to No. 3 he may and most likely will find he has to make another change. But supposing his coupling

FIG. 2.





WAGONS ON A VERY SHARP CURVE.

or fittings have in some way to go through the head stock or buffer beam, then he must first discover some one point where he can be sure of a clear space through every single wagon built in the United Kingdom if he is to succeed. What our first three wagons have done to make that impossible you will readily see, for I have placed all three one over each other, and you will see at once that the central longitudinal timbers of these three types alone, practically fill up all the space he wants to get through and the different bolts already on the wagons stop his fixing all along the buffer beam.

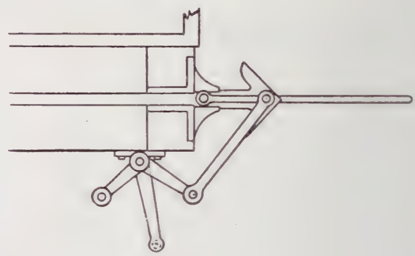
TYPES OF COUPLERS.

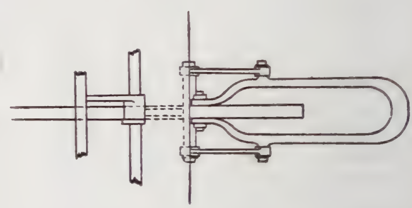
To anyone who investigates this question from the standpoint of invention, it is curious to see on what a settled range of types or patterns the inventive mind runs, and I now show you a few examples which appeared in my paper in 1876, and if any one cares to wade through the 1,500 coupling patents at the Patent Office, he will find the five patterns here presented are repeated again and again with variations, from 1825 to 1902.

Let us briefly glance at them :—

Fig. 2. Here is an endeavour, by means of levers or cranks, to place the present chains or a long link slung on one wagon on to the drawhook of the other; in some years there have been 20 to 30 patents of this type—either to be worked by hand entirely, or set automatically on the

FIG. 3.





contact of wagons. They mostly fail finally in the matter of curves, and we have here a sharp curve which will show you that not only do the wagons approach each other at a given angle, but that the positions of the wagons do not become relatively the same, and that a coupled wagon with lever apparatus is handicapped beyond recovery.

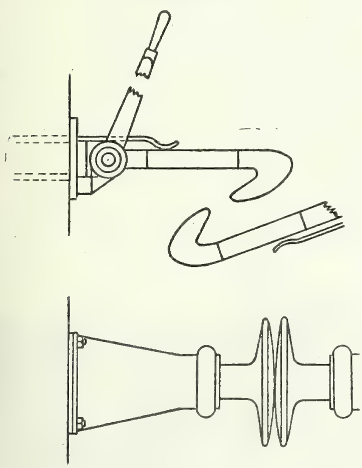
Fig. 3. This is a variation of the same aim, but with an arrow-headed drawbar and a single rigid link. This is one of the automatic efforts. Its rigidity on curves and unflexible link, condenmed it.

Fig. 4. In this type there is something of the American idea, deep-sided vertical hooks all turned the same way, the disconnection being accomplished by drawing back one or other of the hooks. I will simply say that of all the

many varieties of this type I have never seen one which can be adopted for British traffic.

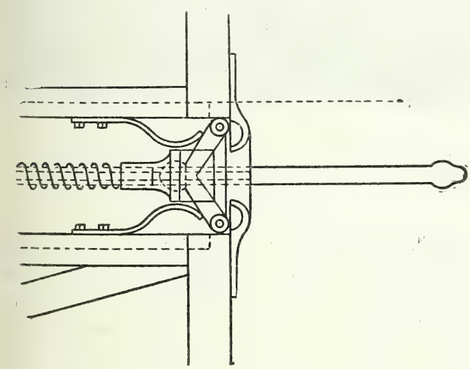
Fig. 5. There have not been many of this type, but it merits attention as very ingenious. The drawhook of the wagon is removed and jaws

FIG. 4.



controlled by springs are put in its place, a round pointed bar is inserted in those jaws, and on being run against another vehicle provided with like jaws, the bar enters between those jaws by which it is held, and the connection is made. To disconnect, the jaws are opened and the bar is free to go out.

FIG. 5



Need I point out that, with a congested traffic to keep going during the period of alteration, there is little hope for this pattern, even if it should fulfil all other conditions.

Fig. 6. We have here, in elevation and plan, a coupling, counterbalanced by weights. It is simple enough, but on many points its rigidity and balance weights prove it impossible.

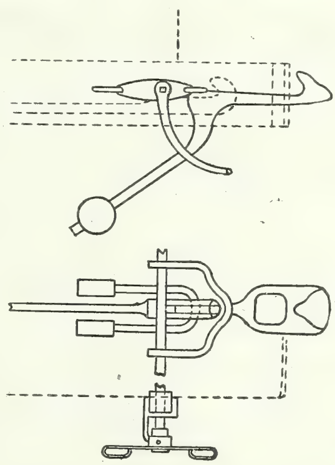
UNITED STATES COUPLERS.

Let us now have a look at the United States Centre Buffer Coupler which, even if it had only saved 53,000 shunters, would certainly merit our attention, but it deserves our consideration as a most ingenious mechanical contrivance, and a clever and successful effort to accomplish a great task.

THE COUPLER.

The coupler consists of a coupler body, and in appearance as shown not unlike the fingers of a hand bent at the knuckles towards a thumb—the finger part is jointed and moves on a pin, and between the fingers is seen a fixed tongue, which on the entry of the jointed fingers of a like coupler, is shot back behind a pin and the connection becomes automatically locked, until the locking pin is lifted, when the disconnection becomes complete, the couplers being reset as they disengage and the fingers turning on the joint being pulled outwards.

FIG. 6.



FREIGHT CARS APPROACHING TO COUPLE.

Here are two freight cars approaching each other to connect by impact. It will be noticed that the side buffers we are accustomed to see on our goods wagons are wanting, this coupler itself acting both as coupler and buffer.

FREIGHT CARS COUPLED.

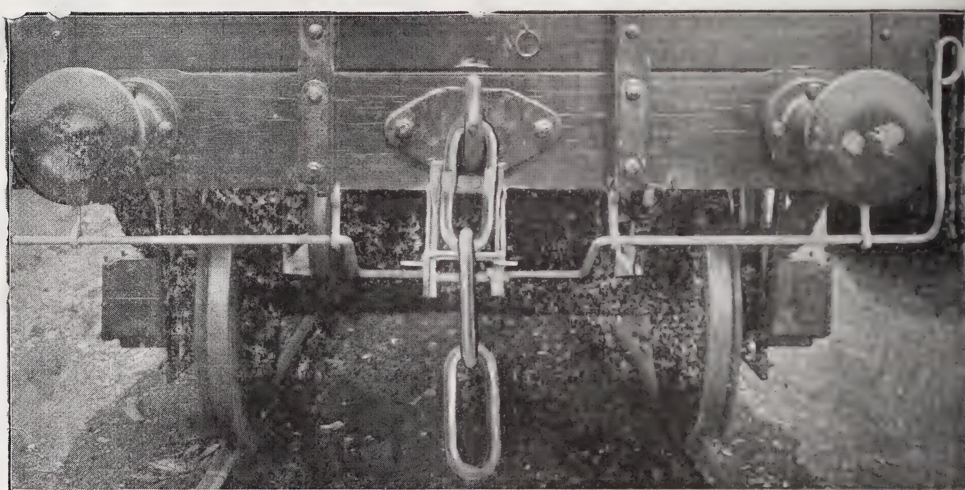
Here we see the couplers securely locked into each other ready for their journey, whilst all that is necessary for disconnection, is to lift the handle and raise the locking pin before referred to.

It was not to be expected that a gigantic transformation involving 3,000,000 of couplers, supplied by all sorts of manufacturers, would forthwith prove perfection. The report of 1902 speaks of bad material or workmanship, which leads to violent impact being necessary to obtain complete connection, that the uncoupling levers or rods will have to be improved on, and that the locking pins need looking after; but in spite of such temporary difficulties we have already seen that the results attained fully justify the change.

FIG. 7.—ENGLISH COUPLING TRANSFORMED.

The Wagon Coupling Links left untouched, are here awaiting change to Automatic Coupling.

STEP No. 1.



Meanwhile the gear for Coupling and Uncoupling the Automatic Coupler by hand has been placed in position, without moving a bolt in the wagon underframe or affecting the traffic of to-day.

In two points particularly these centre buffer couplers are unsuitable for the wagon stock of this country. Their automatic connection is unreliable on sharp curves on impact, and in the United States there have been many devices invented to secure working, but they are all temporary expedients, as far as I have seen, for the very plan of the apparatus is against sharp curves.

The second point is that of fitting them on our wagons. Here the variety of wagon types constitutes a complete block, and they are never likely to come into use in this country.

THE BROCKELBANK COUPLER.

We now pass on to this coupler, and I will try to explain as shortly as I can, how it provides for the differing constructions of wagons, and the ever varying conditions and positions into which our goods wagons find themselves when running haphazard in the irresponsible way they seem to do in our regular traffic.

The Fitting.—This is very simple; a bent lever with a cranked handle at each end supported by four brackets bolted underneath the wagons. Directly under the drawhook-plate of the wagon is bolted a very simple bracket, also of bent steel 3-8ths of an inch thick, bent to a desired shape.

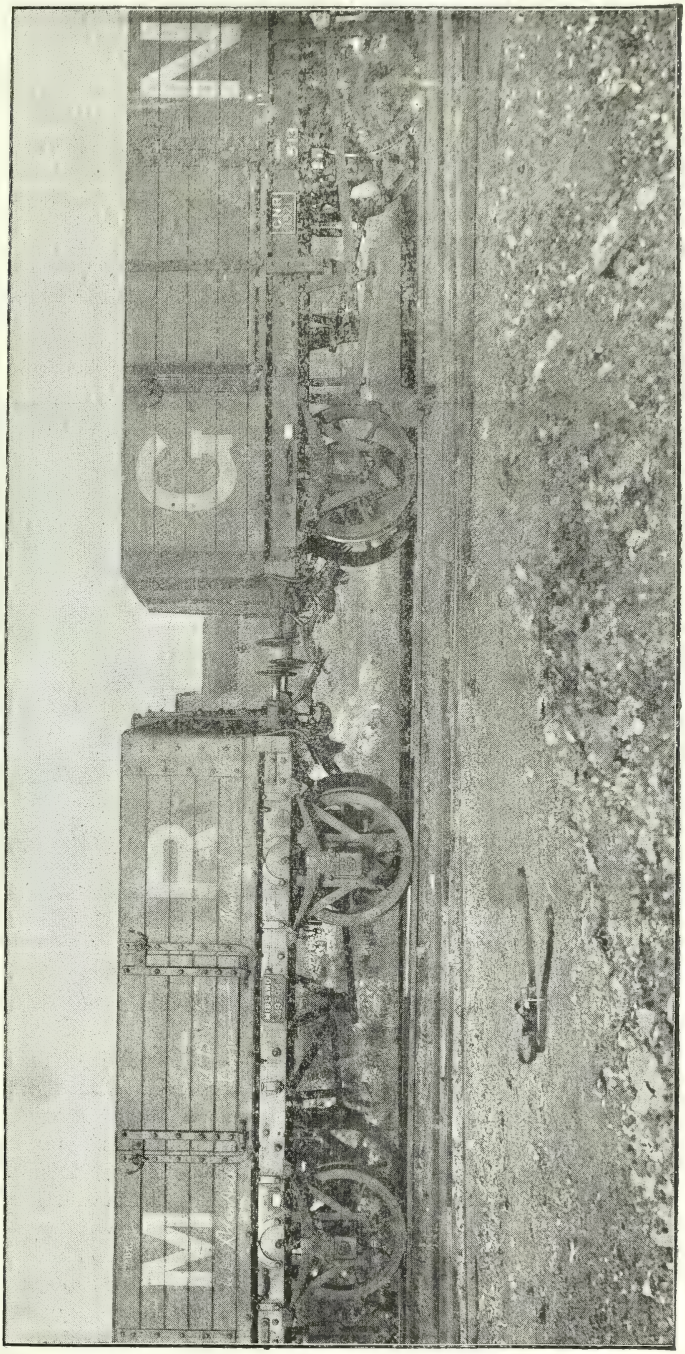
On this is slung a tippler again made of 3-8th steel in two plates bent, but each plate bent shaped differently before bolting together; this tippler, when actuated by the lever, which passes behind it, lifts and releases the coupler or drops it into connection.

It will be perceived at once by any railway man that by this simple process we get clear of all necessity to consider what sort of underframe or longitudinal timbers there are on a wagon. It does not matter with this coupler, which is entirely unattached to the fittings, where the brake handles are, as these coupler handles need never go near them, whilst the fastening bolts in wagons (which we saw on Fig. 1) may practically monopolise the buffer beam, but need not disturb us, for if it should

be found that any railways or railway wagon builders have devised some further complications, we can grapple with them.

which is only about 16 inches, and is worked shoulder high by the shunter who is free to look after his own safety unhindered. The

FIG. 8.—MIDLAND AND GREAT NORTHERN RAILWAY GOODS WAGONS.



Coupled up by impact on a curve, with space between outside buffers 12 inches. These wagons had just previously coupled up automatically on a curve so sharp that there were 19 inches between outside buffers, but too close to a wall to have them photographed.

This is all that is required for coupling or uncoupling the wagon, or setting for automatic action by hand lever, the stroke length of

couplers take the place of the three link chain, being slung in the same slot in drawhook from which they hang to-day.

The next illustration shows two wagons connected on a curve by impact. The representation of the couplers hauling the train gives a clear representation of it at work in actual traffic, and looking down from the point * we can see how well within the length of drawhook the whole apparatus is kept.

RAILWAY SCEPTICISM.

At a meeting of shareholders of the London and North-Western Railway in August, 1899, the chairman, Lord Stalbridge, when dealing with the Royal Commission then appointed to enquire into the accidents to railway servants, said :—

"The first cause of the Royal Commisssion was the introduction by the Board of Trade of a Bill which proposed to force on the railway companies at a definite or indefinite time, according to the sweet will of the Board of Trade, *an invention which did not at present exist, and that was an automatic coupling suitable for the railway wagons of this country*."

He spoke of course from information supplied him.

But this is true, that over two years earlier this coupler had been submitted in model to his own chief wagon superintendent, who ha[d] volunteered the opinion that it would work— but upon my asking the use of wagons t[o] prove its qualifications he refused me an[y] facilities whatever, and one of his colleague[s] dismissed me with "We have no money t[o] waste on safety appliances for servants."

My reply to that dismissal is this, th[e] London and North-Western Railway will sav[e] in working expenses and improved despatch o[f] traffic over 50 per cent. per annum, on what i[t] will cost it to fit up their entire stock of 70,00[0] goods wagons ; it will pay for itself inside tw[o] years, and thereafter that annual saving wi[ll] be available for dividends to its shareholders.

This system of coupler is but the develop[-]ment of a successful idea years older, and th[e] little train which I now show on the lanter[n] screen was worked most successfully at Nin[e] Elms goods yard, and was inspected by [a] representative of the Board of Trade an[d] others in 1899, the year of Mr. Ritchie'[s] Couplings Bill, and I hold the highest writte[n] authority to declare that it worked well. Th[e] wagons on that train you will see had thei[r] lever handles slung below the wagons, an[d] that plan was made effective on fifteen differin[g]

FIG. 9.—THE AUTOMATIC COUPLING.

Is slung in the same drawhook slot as was occupied by the wagon links, and the Brockelbank Coupler automatically connects by impact with any wagon like fitted.

STEP NO. 2.

The couplers are here seen from inside one of the wagons at work looking down from above on to the permanent way as the Couplers are hauling the train. The drawhooks being plainly seen appearing between the coupler links.

ypes of wagons, only to find that different plans of gearing must be devised for different groups or types for constructed wagons, unless one simple system that would easily attach to the lot could be provided.

It took about a month to think that out, about another six months to get it made to my own ideas, and then about a year to try it on wagons of various companies where I could, so as to arrive at this one pattern that would do for any width of wagon. For be it known that although I have applied to 14 large railways about six times either direct or through the press since 1896, such a possibility of proving my work in that way has been as repeatedly denied me, and I have had just to make my own opportunities, and seize them where I could.

Result Achieved.

To-day, however, I am able to declare that not only has this coupler worked in regular traffic with some of the heaviest traffic on the sharpest curves and stiffest gradients in the kingdom, but the very determination of a certain large railway not to have an automatic coupler running over its lines on any conditions has proved absolutely that the fittings once put on wagons can be run with the old links, manipulated by the shunting pole without a fault until the last five minutes of alteration.

To-night you see the way to beat the United States record, in the adoption of automatic couplers, and instead of gradual alteration being necessary with enormous traffic difficulties extending over ten years, we can simultaneously change from shunting pole and chains manual working to automatic coupling inside any settled 24 hours throughout the kingdom, despite the 100 varieties of wagons.

This record will astonish anyone who reads it. They will be even more surprised when they discover that from July, 1900 (or for nearly three years) the Board of Trade has held full powers by Act of Parliament to make all the arrangements necessary to test safety appliances on railways and to test them itself, and that the railways under that same Act are bound to provide the Board of Trade with all necessary vehicles, and every traffic working facility for such purpose. From that date to this, those powers have been left idle and unused by the Board of Trade. Why?

Railway Disclaimer.

Yet in 1899 seven chairmen and directors of different railways, speaking on behalf of the whole body of the railways of the United Kingdom, publicly disclaimed strongly against "the imputation conveyed by the Bill that compulsion by the Board of Trade is required for the introduction of proved safety appliances in railway working; it has been, and is, the earnest endeavour of railway officers and boards to reduce the risks incurred by their servants."

The enquiry then suggested has since been made, and railways have been condemned by a Royal Commission in every particular.

Obdurate Railways.

Of the obdurate character of railways as a body one can hardly speak too strongly, it is largely the outcome of the immense Parliamentary influence they hold, and the fact that each of the hundred companies is a kingdom in itself jealous of each other. The regal chairman, the suave general manager, the important director, and the dictatorial engineer, are all convinced that their own management and rule are unequalled, they are most admirable cold water powers with which to extinguish the burning zeal of inventors, but when the result of this situation extinguishes 20 millions of dividends to shareholders and sacrifices, as it has done in the past, railway passengers' lives and limbs and railway servants' lives and limbs, it is surely time something drastic was done.

One large wagon owner not so long since told me concerning another important alteration on railways other than couplers demanded by the Royal Commission, that he confidently expected that railways will be able to hold off compulsory adoption for 25 years. Three years of that period are already gone, and as matters are tending it cannot be completed within 15 years.

From one undertaking which owns 4,000 wagons, and of whose seven directors, three are railway directors, I hold the following written declaration of unending resistance to automatic coupling:—"It is perfectly certain that automatic couplers will never come into use generally in this country unless it is through legislative action." "We shall certainly not use any description of automatic coupling unless forced to do so."

Royal Commission, 1874.

In 1875, I discussed this question with the Earl of Aberdeen, the late Earl de la Warr, and the late Mr. Galt, all members of the 1874 Commission on Passenger Safety.

They expressed a strong opinion as to the urgency of the matter of railway servants' accidents, and their regret that the terms of reference of that Commission did not include it, and if anyone thinks the Royal Commission and Act of Parliament of 1900 on Railway Servants safety will convert railways from the error of their ways, let us look back and see how railway passengers fared only 25 years ago, as a result of the findings of that Commission of 1874, and endeavour to forecast from those experiences how long it may take to secure even reasonable safety to the railway servant.

Safety to Passengers.

This Royal Commission revealed such terrible results to passengers on railways of the United Kingdom, that Parliament insisted that safety appliances on their behalf should be provided by the railways.

From 1870 to 1878, the number of passengers killed and injured by collisions between passenger and goods trains only, reached 4,000 passengers alone. Such, however, was the scandalously slow provision of automatic passenger brakes and block signalling, that their adoption trailed over twenty years, the Great Eastern Railway in 1886 having still only partly carried out the Board of Trade requirements.

During that process, thousands of passengers were needlessly killed or injured with hundreds of servants employed on those trains, whilst still worse, railway servants by the score were committed for trial for manslaughter for collisions contributed to, and in many cases actually brought about by the non-provision of the safety appliances in working ordered by Parliament in 1875.

At last, in 1903, such appliances for passenger safety are practically in universal use, with the result that on a railway journey a passenger is safer than when crossing a busy street.

A Retrospect.

Looking back over 30 years I do not find it easy to forget the heartless instances of unconcern as to railway servants' dangers which confronted me almost at every turn, whilst I gladly acknowledge a few noteworthy exceptions.

The words of a once well-known engineer in 1874, however, braced me to persevere. He said, "Your idea is good, you may eventually carry through your task, but with my experience of over 30 years with railways, I tell you, yo had better break stones for a living, than hav anything to do with railways; they will sen you from pillar to post until they have worn yo out and sucked your brains, and for all the care you may die in the workhouse."

My reply, and I repeat that reply her to-night, was this:—So long as railway ser vants are so shamelessly and needlessly kille and injured, and so long as I can see the wa to save them, God helping me, I will neve rest.

This occurred in the private room of Mr Baldry, of John Fowler and Co., Queen Anne's buildings, Westminster, in 1874.

Since I first took up this question in 187 there is little doubt that between 25,000 an 30,000 men on railways and in private yard have fallen victims to the methods of couplin and uncoupling on the railway vehicles of thi humane country.

Railway Torpidity.

It should not, however, be overlooked tha on certain railways, improvements and couplin inventions have had some attention. Trial and tests have been made where coupling in ventions were either owned or favoured b business customers whom it was not policy t refuse. Some officials also who favour some lin lifting apparatus, others who inclined to centr buffer ideas, have allowed fittings on the wagons, and on the Great Northern Railwa about two years since, there was a misce laneous assemblage of such ideas, but in eac instance it was the inventor or the inventor' supporters who have initiated these attempt and had to stand the racket of them.

Under such conditions, no definite progres was ever possible, it has been simply frivollin with a great and far-reaching subject.

Contrast this with the business-like an comprehensive method adopted on the Unite States railroads.

There over twenty years ago, every inventio was tried on a given plan, photographed o the like conditions and at a certain distanc from the camera, all the details were carefull recorded and its performance duly noted, an if it was improved on, it was again thus sub jected to competition with its past record, an this went on until there emerged from thes trials, that definite and remarkable Unite States Master Builders' Pattern Centre Buffe Coupler which we have just examined.

With the diversity of interests and opposin characters of the railways of the Unite

Kingdom, it is hopeless to expect a settlement by them, and anything short of public testing and final selection by the Board of Trade, and compulsory enforced adoption of that selection is hopeless in this country.

Summary.

1. We have seen that humanity demands the adoption of automatic couplings in this country.

2. We have learnt from United States railroad experiences that when adopted automatic couplings pay well.

3. We have discovered that during alteration the immense complex traffic of the United Kingdom need not suffer.

4. We see that there is reason to expect great acceleration of traffic and reduction in expenses.

In closing this paper I desire to express my sincere acknowledgments to Sir Charles Owens and the Directors of the London and South-Western Railway for the facilities granted me from time to time to work out my improvements.

Without some such opportunities, it would have been totally impossible for any coupler inventor to discover what difficulties have to be confronted and whether even the most ingeniously designed appliance can grapple with them.

This question is now one for the House of Commons and the Nation ; nothing less can settle it decisively in the face of railway opposition and Board of Trade apathy.

DISCUSSION.

The Chairman said the details which had been given were very new to most of those present, and the great mortality amongst the *employés* on the railways was astonishing. They must not, however, be led away by that, because similar conditions existed in other trades. At the present moment the Society, in company with one of the Government Departments, was making investigations in another trade, with a view to reducing its mortality, and the Board of Trade were taking some steps to effect improvements in couplings. A leading official of one of the large railways had told him that he could best explain why this country was so far behind in the adoption of automatic couplings by an abstract from a report of Colonel Yorke, recently made to the Board of Trade :—"The law of the American Congress relating to the use of automatic couplings and air-brakes on all freight trains engaged in inter-State commerce came into full force on the 1st August, 1900, and the 15th Annual Report of the inter-State Commission, published in 1902, is a highly interesting document. From this, it appears that the coupling mechanism is still far from perfect, especially in regard to the uncoupling attachments. Another common defect in couplers, and one which is the cause of much trouble and expense to railroads, is the breakage of the knuckle. The Commissioners are evidently not satisfied with the couplers as at present used, for the report says, 'It will be seen that the needs of the future in respect of couplers, may be described under the heads of strength, simplicity, and finish.'" He had read that to show that the Board of Trade were fully alive to the necessity of doing something in the way of an automatic coupler. But it was a very expensive thing for the Board of Trade to insist upon railways adopting any given coupler. The risk was very great. Some figures had been given as to the cost of fitting the whole rolling stock of a railway, and it would be seen how gigantic they were. No Government Department could insist upon it until they were perfectly certain that they had succeeded in obtaining a really first-class coupler, one which would last for years to come. Years ago an English railway company had adopted a special brake of its own. The Westinghouse and the vacuum brake then came in and that railway had to throw away all its brakes, which were most expensive, and go in for the other system. The loss was prodigious. In face of that every railway company was cautious in adopting a coupler it was not really satisfied with. At the present time duplication was being seriously considered by the Institution of Civil Engineers, which had appointed a committee, under the guidance of a Government Department, in order to duplicate the various sections of girders, the various fittings on railways, locomotives, and rolling-stock generally. Until there was more duplication, this country would not easily adopt an automatic coupler. Again, this country was very different from the United States. The United States' railways were very much larger systems, and the interchange of traffic from one railway to another was very much greater in this country. Unless all our railways adopted an automatic coupler at the same time the difficulties of interchange of traffic would be exceedingly great. That militated very considerably against the adoption of an automatic coupler. On the Barry Railway, of course, the wagons were coupled together.

Mr. Allison Smith said he was a railway man of 30 years' experience, and had been through all the mechanical grades. He entirely endorsed all that Mr. Brockelbank had said as to the necessity for an automatic coupler. He was, in fact, a rival, having an invention of his own on the subject. Mr. Brockelbank's figures were practically identical with those he had himself worked out. The difficulty of introducing an automatic coupling in England, was much less

than people imagined; it only wanted to be tackled. It was difficult to get everybody of one mind at once, and he agreed that, unless the Board of Trade took the matter in hand, nothing would be done, considering the conflicting interests of the different railway companies, the demands of the shareholders, and so on. Speaking as an expert, he declared that in two years the increased earnings of the wagons alone would pay for the total cost of the conversion. That point should be well drilled into shareholders.

Mr. E. CALTHROP said, that in India, he had kept statistics for a number of years with regard to the working of ordinary couplings in use. Of the total number of accidents to wagons, above 80 per cent. had been due to defects in couplings and draw-gear, so that the adoption of an improved system would make an immense saving in the way of repairs. One objection to Mr. Brockelbank's invention was that it was what was known technically as a "slack coupling"—there was a very large amount of slack between the two wagons. His experience, as a locomotive engineer, had been that the greater the amount of slack between the heads of the couplings the greater damage there was done in shunting, and other operations. In the case of the failure of a coupling, it was not only the original damage which was done to a chain, or to the bar itself, but the whole head stock was pulled out, the under-frame was damaged, and perhaps that would occur to four or five other wagons as well. There was no doubt that it was impossible for any one railway company to say they would adopt those couplings for the reasons which the Chairman had stated so ably; it must come through Parliamentary action. One knew there was a huge mortality on railways, but there was no visible sign of any attempt to select a coupling. The Government was doing nothing in the matter. One heard from time to time that there was a possibility of legislation, but if legislation was to be successful there must be some attempt to select a coupling first. Until that was done everyone must regard the coupling question as being shelved, and outside practical politics. Railway *employés*, railway shareholders, and railway directors alike would be glad to see some system of experiments adopted.

Mr. F. DAVIS said he was a large private wagon owner. One important point in favour of Mr. Brockelbank's invention was that his couplings had been working on the Barry Railway and had gone on the Great Western Railway, showing there was an interchange of traffic, with different conditions on the different lines. That seemed an element of danger to railway companies and wagon owners in this way, that it looked as if the use of automatic couplings ought be very much nearer at hand than some of them thought. He was interested in the point that the coupler could be fitted to wagons of any make or shape, and they could be run with the coupling apparatus fixed on to the wagons but not working, the ordinary links being used.

The CHAIRMAN asked Mr. Brockelbank to explain how the Barry wagons ran on the Great Western in company with their wagons.

Mr. BROCKELBANK said when it was found necessary to fasten these wagons to wagons with the present system of couplings, they simply used the ordinary links. Those wagons were now running over the Great Western, with the ordinary links on, and within five minutes they could be altered from the ordinary running links to automatic couplings.

Mr. F. W. EVANS said he did not speak as an expert, but had for many years taken an interest in promoting the adoption of automatic coupling from motives of humanity. For some 30 years he had known Mr. Brockelbank, who had given practically the whole of his life to the subject. Yet now we seemed no further forward than we were 30 years ago. A letter appeared in the *Times* as far back as the 8th December, 1876, in which it was stated that "the operation of shunting is the most dangerous occupation on railways. No less than one in every 20 so employed is either killed or injured. To modify the danger incurred many ingenious wagon couplings have been invented. The most successful is that of Mr. Brockelbank, to which Captain Tyler draws attention in his reports on accidents for the year 1875. A train has been fitted with this coupling, and for the last twelve months has been put to every conceivable test, and proved to answer. Surely it was the duty of railway companies either to devise some means of avoiding the danger incurred by the present system of coupling or to accept and put in operation the means which others have devised to this end." That letter was signed by himself, then the General Secretary of the Amalgamated Society of Railway Servants. That appeal was still needed to-day. In 1882 he had been instrumental in arranging for an exhibition of improved wagon couplings and other safety appliances at Darlington. There were as many as 46 exhibits from the other side of the Atlantic; Frenchmen, and many from Belgium, sent exhibits; and the companies sent specimens of all the various links used in the United Kingdom. Some of the most noted railway engineers were the judges, and amongst those who obtained the highest award on that occasion was Mr. Brockelbank. Another who did so was the inventor of the knuckle coupling, which had since not only been adopted in America, but compulsorily applied to all the inter-State traffic on the railroads there. Since then inventions have been so numerous that they would almost sink the navy; but the only effect upon the companies had been that they had agreed more or less to adopt the free link coupling, and had sanctioned the use of the shunting stick or pole, which had crept into use clandestinely on the railways before it was officially sanctioned. One in every 20 shunters was killed or injured each year

nd 1 in every 45 guards, porters, and shunters ngaged in shunting. During the last ten years, ,250 out of a mean number of 21,000 engaged in hunting operations had been killed or injured—two n every seven. Nothing would be done until force vas used. In America the same or a worse state of hings had existed. Petitions were presented by the ailroad men to various humane persons, and to the President of the United States, pointing out the laughter on railways. In 1893, Congress passed in Act compelling all the railroad companies within ive years, to apply automatic couplings to all their ars and carriages. To-day, 95 per cent. of the cars vere so fitted, and there had been a decrease of 80 er cent. in the rate of accidents. In this country, fforts to induce the Board of Trade to move had iot been successful. Mr. Ritchie obtained the anction of the Cabinet to bring in a Bill in 1899. That Bill was very much better than the Act passed n 1900. So great was the pressure from the Cabinet, where there were eleven railway directors, that Mr. Ritchie was bound to drop his Bill, but he btained consent to a Royal Commission, and hen a Bill was passed in 1900. The substance was his: – "The Board of Trade may, by any rules made inder this section, require, amongst other matters, he use of any plant or appliance which has been hown to the satisfaction of the Board of Trade to be alculated to reduce danger to persons employed on a ailway." Three years had elapsed, and what had een done? By the companies, nothing! By the Board of Trade, nothing! A fortnight ago, Mr. ierald Balfour said: "The Board of Trade had not xercised its power to make experiments with couplings nd other appliances, nor did he consider it desirable hat the Board should do so. A great number of igenious people were engaged in the solution of the roblem, and the time had not arrived for the Board f Trade to take the matter up. He thought a more atisfactory result was likely to be arrived at by private nterprise than by the action of a Government depart- ient." In other words Mr. Gerald Balfour told them hat the Act was a snare and a delusion, a mere sham. Nothing was to be done but to make the matter a olitical question, to take it to the constituencies, to ake it before the great mass of workers in the country, nd show them that the selfishness and greed of he companies prevented their action.

Lieut.-Colonel ALLAN CUNNINGHAM asked whether the lamentable picture of loss of life had een overdrawn. It occurred to him that it might e loss of life from all causes.

Mr. BROCKELBANK said nothing else but coupling ccidents had been included in the figures, and they ad been taken from the Board of Trade returns year y year.

Colonel CUNNINGHAM said the question was a ifficult one for the Government to take up in face f the railway interests, and he suggested two bodies who might take it up—the Society of Arts, which would have considerable weight, or the Institution of Civil Engineers. The latter could themselves make experiments and recommend definite couplings to the Board of Trade.

The CHAIRMAN reminded the speaker that a committee of the Institution of Civil Engineers was sitting to look into such matters, and it was very probable they would take up that question.

Colonel CUNNINGHAM said there was one other point, viz., that the automatic coupling of Mr. Brockelbank was apparently only intended for goods trains; it did not seem at all fitted for passenger trains.

Mr. BROCKELBANK, in reply, thought the suggestion as to the committees was a good one, but unless they got the Board of Trade at their back they could not require the railways to give them facilities for trials, or to lend them the wagons of various types, which were absolutely necessary. For six or seven years he had applied to fourteen of the largest railways of the United Kingdom, asking them to give him two wagons each, to make up a train, but they had refused. As to whether it would do for passenger carriages, he had taken a slightly different apparatus to Mr. Speck of the District Railway, in 1874, after it had been rejected by every railway in the United Kingdom. Mr. Speck said it was a splendid idea, and gave him an engine and a couple of carriages on the District Railway, and the apparatus was made at their works. That was a tightening apparatus, by which they could let the train run down an incline, go after it and pick it up, and tighten up when it was going, and it never failed The reason it was not taken up, was that Mr. Speck said the Board of Trade would never sanction it upon an underground railway until it had been worked by an ordinary railway. He was then an unknown man, and had made the apparatus, and he had not the money to go further. He could also give loose automatic side chains, so that they would work, even if the coupling tightening apparatus gave way, in fact, he was now doing it for Belguim and France.

The CHAIRMAN moved a vote of thanks to Mr. Brockelbank for his interesting paper, and this having been carried, the proceedings terminated.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evening, at Eight o'clock:—

MAY 6.—"The Construction of Maps and Charts." By G. J. MORRISON. SIR WILLIAM WHARTON, K.C.B, Hydrographer to the Navy, will preside.

MAY 13.—"Preservation of Big Game in Africa." By E. NORTH BUXTON. SIR JOHN KIRK, G.C.M.G., K.C.B., will preside.

MAY 20.—"Fencing as an Art and an Historic Sport." By EGERTON CASTLE, M.A.

INDIAN SECTION.

Thursday Afternoon, at 4.30 o'clock :—

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D. The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M P., will preside.

COLONIAL SECTION.

Tuesday Afternoon, at 4.30 o'clock :—

MAY 5, at 4.30 p m.—"The Lagos Hinterland: its People and its Products." By MAJOR J. H. EWART. SIR John SMALMAN SMITH, M.A., will preside.

APPLIED ART SECTION.

Tuesday Afternoon, at 4.30 o'clock :—

MAY 19.—"Mezzotints." By CYRIL DAVENPORT, F.S.A.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

W. WORBY BEAUMONT, Mem.Inst.C.E., "Mechanical Road Vehicles." Four Lectures.

LECTURE II.—MAY 4.—The industry in 1897—Richmond Show—Types of vehicles made, 1897-1899, power and weight—The motor, transmission gear, tires, speed, trials and races – Heavy vehicles—Trading vehicles.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 4...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. W. Worby Beaumont, "Mechanical Road Vehicles." (Lecture II.)

Farmers' Club, Salisbury-square Hotel, Fleet-street, E.C., 4 p.m. Mr. Rew, "Recent Changes in the Number of Cattle and Sheep in Great Britain."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. David B. Butler, "Certain Vexatious and Fallacious Cement Tests now in vogue."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Dr. Julius Lewkowitsch, "Problems in the Fat Industry."

British Architects, 9, Conduit-street, W., 8 p.m. Annual Meeting.

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. Cyril Davenport, "Beautiful Jewellery."

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. Theophilus G. Pinches, "Report on the Congress of Orientalists held at Hamburg, together with a short Description of the Laws of Hammurabi, the Amraphel of Genesis, Ch xiv., as engraved on the recently discovered monument."

TUESDAY, MAY 5...SOCIETY OF ARTS, John-street, Adelphi, 4½ p.m. (Colonial Section.) Major J. H. Ewart, "The Lagos Hinterland: its People and its Products."

Royal Institution, Albemarle-street, W., 5 p.m. Allan Macfadyen, "The Blood and some of its Problems. (Lecture III.)

Alpine Club, 23, Savile-row, W., 8½ p m.

Pathological, 20, Hanover-square, W., 8½ p.m.

Anthropological, 3 Hanover-square, W., 8½ p.m.

WEDNESDAY, MAY 6...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. G. J. Morrison, "The Construction of Maps and Charts."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. 1. Prof. W. Boyd Dawkins, "The Pre-Roman and Roman Roads of South-Eastern England." 2. Mr. Talfourd Ely, "A Roman Lighthouse."

British Archæological Association, 32, Sackville-street, W., 4½ p.m. Annual Meeting.

Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, MAY 7...Surveyors, Leinster-house, Dublin, 10 a m. General Meeting.

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Dr. H. J. Hansen, "The Ingolfiellidæ, fam. nov., a new type of Amphipoda." 2. Mr. A. Bensley, "The Evolution of the Marsupials of Australia." 3. Rev. Canon Norman, "Copepoda Calanoida from the Faröe Channel, and other parts of the North Atlantic."

United Service Institution, Whitehall, S.W., 3 p.m. Captain R. A. Steel, "Pekin under the Allies."

Chemical, Burlington-house, W., 8 p.m. 1. Mr. T. M. Lowry, "β-Bromonitrocamphor and β-bromocamphoryloxima. Influence of impurities in conditioning dynamic isomorism." 2. Mr. T. M. Lowry, "Spontaneous Decomposition of Nitrocamphor." 3. Mr. E. G. Hill, "The active Constituents of Butea Frondosa." 4. Mr. H. M. Dawson, "The Relative Affinities of Polybasic Acids."

Iron and Steel Institute, 25, Great George-street, S.W., 10½ a.m. 1. Annual Meeting. Inaugural Address by the President, Mr. W. Whitwell. 2. Reading of papers and discussions. 9½ p.m. Reception by the President at the Institute of Painters in Water-Colours, Piccadilly, W.

Society for the Encouragement of Fine Arts, 6½ Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. T. R. Ablett, "Pictorial Imagination expressed by Snapshot Drawing."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. Dewar, "Hydrogen—Gaseous, Liquid, and Solid." (Lecture III.)

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. C. E. Stromeyer, "The choice of Steam Boilers."

Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. 1. Mr. A. D. Williamson, "Applications of Electricity in Engineering and Shipbuilding Works." 2. Mr. A. B. Chatwood, "Electric Driving in Machine Shops."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. W. H. Shrubsole, "A Holiday Ramble in Hungary."

FRIDAY, MAY 8...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Mr. H. Rider Haggard, "Rural England."

Iron and Steel Institute, 25, Great George-street, S.W., 10½ a.m. Annual Meeting resumed. Reading of papers and discussions.

Astronomical, Burlington-house, 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

SATURDAY, MAY 9...Botanic, Inner Circle, Regent's park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. Hamish MacCunn, "Music." (Lecture I.)

Journal of the Society of Arts,

No. 2,633. Vol. LI.

FRIDAY, MAY 8, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

MONDAY, MAY 11, 8 p.m. (Cantor Lecture.) W. WORBY BEAUMONT, M.Inst.C.E., "Mechanical Road Vehicles." (Lecture III.)

WEDNESDAY, MAY 13, 8 p.m. (Ordinary Meeting.) E. NORTH BUXTON, "The Preservation of Big Game in Africa."

THURSDAY, MAY 14, 8 p.m. (Indian Section.) SIR CHARLES JAMES LYALL, K.C.S.I., LL.D., "The Province of Assam."

Further details of the Society's meetings will be found at the end of this number.

PRIZE FOR A DUST-ARRESTING RESPIRATOR.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Prize of a Gold Medal, or Twenty Pounds, for the best Dust-Arresting Respirator for use in dusty processes, and in dangerous trades.

The Council are well aware that for many years past the necessity for such an apparatus has been recognised. As far back as 1822 the Society awarded its Gold Medal to Mr. J. H. Abraham, of Sheffield, for a Magnetic Guard to protect persons employed in dry grinding. The apparatus described in the Society's "Transactions" (Vol. 40, 1822, page 135) includes a Respirator to cover the mouth and nose. This Respirator was fitted with magnets, for the purpose of arresting the fine particles of steel thrown off in the process of pointing needles, and in other processes of dry grinding. Although the invention was greatly appreciated at the time, it appears never to have come into practical use, the main objection to it having been, it is believed, raised by the workpeople themselves, who feared that the lessened risk attached to their employment would lower their wages. Similar considerations have, it is believed, stood in the way of the introduction of various appliances intended to limit the risks associated with all trades in which the workpeople breathe a dusty atmosphere. The Council, however, think that such considerations are likely to have less weight at the present time, and they hope that the offer of a prize may draw the attention of inventors to the matter, so that it may result in the production of some suitable piece of apparatus, despite the difficulties with which the solution of the problem is surrounded.

The apparatus will be required to fulfil the following conditions:

(1.) It must be light and simple in construction.

(2.) It should be inexpensive, so as to admit of frequent renewal of the filtering medium or of the Respirator as a whole; or alternatively it should be of such construction that it can be readily cleaned.

(3.) It should allow no air to enter by the nostrils or mouth except through the filtering medium.

(4.) It should not permit expired air to be rebreathed.

(5.) The filtering medium, though it should be effective in arresting dust particles, should not offer such resistance as to impede respiration when worn for some hours under the actual conditions of work.

(6.) It is desirable that it should be as little unsightly as possible.

It should be noted that the prize is offered for a Respirator intended merely to arrest dust, and not for a chemical Respirator designed to arrest poisonous fumes. The applications of such chemical Respirators are more limited, and there are special requirements connected with them. The Council have, therefore, preferred to limit the range of their present offer to the simpler and more important cases of dust, either dust of all kinds or of some special character, *e.g.*, iron or steel.

Inventors intending to compete should send in specimens of their inventions not later than 31st December, 1903, to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C. Such specimens must be accompanied by full descriptions, and in cases in which the apparatus has been put into actual use, the experience of such use should be given.

Competitors intending to patent their inventions should be careful to obtain protection, as the Council of the Society cannot undertake any responsibility as regards the secrecy of the whole, or of any part, of an invention submitted to them.

The Prize will be awarded on the report of judges appointed by the Council.

The Competition is not limited to British subjects.

The Council reserve to themselves the right of withholding the Prize, of extending the time for sending in, or of awarding a smaller Prize or smaller Prizes.

CANTOR LECTURES.

On Monday evening, 4th inst., Mr. W. Worby Beaumont, M.Inst.C.E., delivered the second lecture of his course on "Mechanical Road Vehicles."

The lectures will be printed in the *Journal* during the autumn recess.

COLONIAL SECTION.

Tuesday afternoon, May 5, 1903; Sir John Smalman Smith, M.A., in the chair.

The paper read was "The Lagos Hinterland, its People and its Products." By Major J. H. Ewart.

The paper and report of the discussion will be published in a future number of the *Journal*.

Proceedings of the Society.

TWENTIETH ORDINARY MEETING.

Wednesday, May 6, 1903; Rear-Admiral Sir William James Wharton, K.C.B., F.R.S., Hydrographer to the Navy, in the chair.

The following candidates were proposed for election as members of the Society:—

Casson, Thomas, The Positive Organ Co., Limited, 17, Harewood-place, Hanover-square, W.

Cliff, Richard C., A.M.I.E.E., Cape Government Railways, P.O. Box 291, Cape Town, South Africa.

Ellison-Macartney, Right Hon. William Grey, The Royal Mint, E.C.

Gordon, Rev. Charles W., Winnipeg, Manitoba, Canada.

Lewis, Mrs. S. S., Castle-brae, Chesterton-road, Cambridge.

Wainwright, Harry S., South Eastern and Chatham Railway, Ashford, Kent.

The following candidates were balloted for and duly elected members of the Society:—

Aglen, Francis A., Custom House, Nanking, China.

Burdick, Charles L., The Aerograph Company, 30, Memorial-hall, Farringdon-street, E.C.

Clarke, H. E. C., Lealtad 6, Madrid, Spain.

Cornish, Tom, 81, Gracechurch-street, E.C.

De Châtelain, Prof. Michael A., Sosnovka, St. Petersburg, Russia.

Dolbear, Prof. Amos Emerson, Tufts College, Massachusetts, U.S.A.

Free, Rev. Richard, M.A., St. Cuthbert's-lodge, Millwall, E.

Ho Kai, Hon. Dr., C.M.G., M.B., M.R.C.S., 7, West-terrace, Hong Kong, China.

Kearne, Mrs. Isabel, De Lacy, 15, Duke-street, Southport.

Margetson, John, Brightside, Stroud, Glos.

Phillips, Thomas Brice, 4, Aylesford-terrace, Uckfield, Sussex.

Pole, Benjamin Charles, 19, Imperial-buildings, Ludgate-circus, E.C., and Clifton-house, Church-road, Upper Norwood, S.E.

Rayner, William George, 10, Arthur-street West, London bridge, E.C.

Risch, G. H. C., M.I.E.E., Central South African Railways. Johannesburg, Transvaal, South Africa.

Robarts, W. E., 298, Smith-street, Durban, Natal, South Africa.

Savage, Dr. William Arthur, F.G.S., Mapumulo, Natal, South Africa.

Smith, James Henry, Kincraig, Tuxedo-park, New York, and 10, Wall-street, New York City, U.S.A.

Terry, Don Enrique, Chile, and care of Campbell, Everden and Co., Suffolk-house, E.C.

Wood, Thomas Megam, Galway-house, Maybank-road, South Woodford, Essex.

Wyatt, Charles H., M'Kopo Farm, Thaba 'nchu, Orange River Colony, South Africa.

The paper read was—

THE CONSTRUCTION OF MAPS AND CHARTS.

By G. J. Morrison.

The earth being a sphere it is of course possible to make a model of it in the form of a globe, but before the outlines of the various continents can be drawn on the model, their positions on the earth itself must be fixed, and I shall begin by describing very briefly the manner in which this is done.

There is in the heavens a bright star nearly though not quite in the prolongation of the

earth's axis through the north pole. When this star is observed for the purpose of making exact measurements this slight difference is allowed for, but in this paper I shall speak as if it was exactly in the prolongation of the axis, and of course its position on the sky remains fixed because although the earth revolves on its axis, and likewise revolves round the sun the axis remains practically fixed in the same direction, the diameter of the earth's orbit being nothing compared with the distance of the pole star.

If from any point in the earth a telescope be directed to that star its axis will be parallel to the axis of the earth, because although it will point slightly inwards towards the north pole the star is so far off that the amount of this is quite inappreciable.

Now, every one looks upon the part of the earth on which he stands as being the top, and looks on the surface of a sheet of water as being horizontal, consequently any one at the equator will see the star on the horizon. Any one at the pole would see it overhead and any one half-way between the pole and the equator would see it half-way up in the heavens, or in other words the latitude of any place is equal to the angular height of the visible pole in the heavens. At sea the sun or some of the larger stars may be observed instead of the pole star simply because they are brighter, but their distance from the pole is allowed for, and when (as is usual at noon) a notice is stuck up on a ship that her latitude is say, 22° 40′ north, it means that the polar star is 22° 40′ above the horizon and nothing else. If at night in London you look at the north star, you will be able to judge that it is more than half-way from the horizon to the zenith, and less than two-thirds of the way. Then that shows that London is more than half-way from the equator to the pole and less than two-thirds. This is no doubt a very rough approximation, still I daresay many of you never considered before that it was possible to get even this vague idea of your whereabouts on the globe by such simple means. Measurement with an instrument would give the height of the star as $51\frac{1}{2}$ degrees.

This fixes the position north and south, but the position east and west has also to be fixed. Some starting point has to be chosen and the one used over most of the civilised world is the meridian of Greenwich. If you set up a vertical pole at Greenwich its shadow in the morning will be on the west side, and in the evening on the east side, and at a certain moment it will point directly north. At that moment let a watch be set at twelve o'clock. If then an observer wishes to fix the position of some other place he goes there, and in the first place observes (either directly or indirectly) the height of the pole star. Let us say, 42° 10′. He then sets up his vertical staff as before and watches for noon, *i.e.*, for the shadow pointing north, and he finds that it occurs when his Greenwich watch shows 10 a.m. That is to say, the point of observation comes opposite the sun two hours sooner than Greenwich. Now two hours is 1-12th of the entire day; therefore he is 1-12th of the way round the world to the eastward, and there being 360° in the whole circle his longitude is 30° east. There are naturally small allowances to be made, but this gives the general idea. The latitude and longitude thus fixed are definite. The point then can be plotted on any globe on which lines of latitude and longitude have been drawn. Other points can be fixed in the same way, details can be filled in by measurement, and gradually a complete model of the earth can be made.

The extreme inconvenience of a globe for general purposes drives us to maps. It is hardly necessary to tell this audience that the absolutely correct representation of the surface of a sphere on a flat surface is impossible, and what I propose to do to-night is to explain some of the methods employed to make maps which either give good general ideas of the appearance of the whole or of parts of the earth, or which retain some one property of the sphere at the expense of disregarding the others.

Now the first method that will occur to most people is to make a picture of the globe. Such a picture as a map is known as orthographic projection.

Its advantage is that it gives a good idea of the globular form of the earth, but it is terribly crowded towards the edges. On a map of the eastern hemisphere Africa is very close to the edge, and is a long narrow continent. Australia also almost touches the border line. For those interested in the mathematical part of the subject I may point out that the parallels are straight lines and the meridians ellipses. The distance of any point from the centre of the map is equal to the sine of its angular distance from the corresponding point on the globe.

Now, suppose I divide the globe in two at the equator and place a piece of paper there, and suppose for each crossing of a parallel and a meridian I pass in a long wire pointing

in the direction of the south pole, I shall get a series of small holes in the paper through which I can draw a network of lines to represent the parallels and meridians giving a projection which is called stereographic. The diagram which I now show you illustrates this, and here I wish you to note that this laying down of meridians and parallels is all one does in map projection. One lays down a network of such lines in accordance with some rule, and then one draws the outlines of countries, &c., to fit those lines. From the diagram it will be seen that the angular distance of the points, F, H, measured on the sphere from the pole are twice the angles which the lines E, F, E, H, make with the axis, while the lengths, C, G, C, K, are proportional to the tangents of these latter angles. Therefore, distances on the map measured ftom the centre are proportional to the tangents of half their angular distances from the corresponding point on the globe.

It can also be shown that both meridians and parallels are either circles or straight lines, and the projection is, therefore, very easy to draw.

I might have divided the globe down the polar axis and passed wires through from one side towards a point on the other side, and so marked another piece of paper, or better still I might have found by drawing or by calculation where the marks would appear on such a piece of paper. The result would be as in the map of the eastern hemisphere which I now show. (Fig. 2, p. 555.) If you look carefully you will see that the idea of roundness has disappeared, and the shape and apparent position of Africa and Australia are much altered.

The advantage of this map is that each little four-sided figure made up of parallels and meridians is very nearly the same shape as on the globe. On the globe the figures touching the equator are nearly square. On the map also they are nearly square. On the globe at 60° they are twice as long as they are wide. On the map also they are about twice as long as they are wide, while all parallels and meridians cut each other at right angles. Consequently a correct map that would fit one of the four-sided figures on the globe, where, as the area is small, curvature is unimportant,

FIG. 1.*

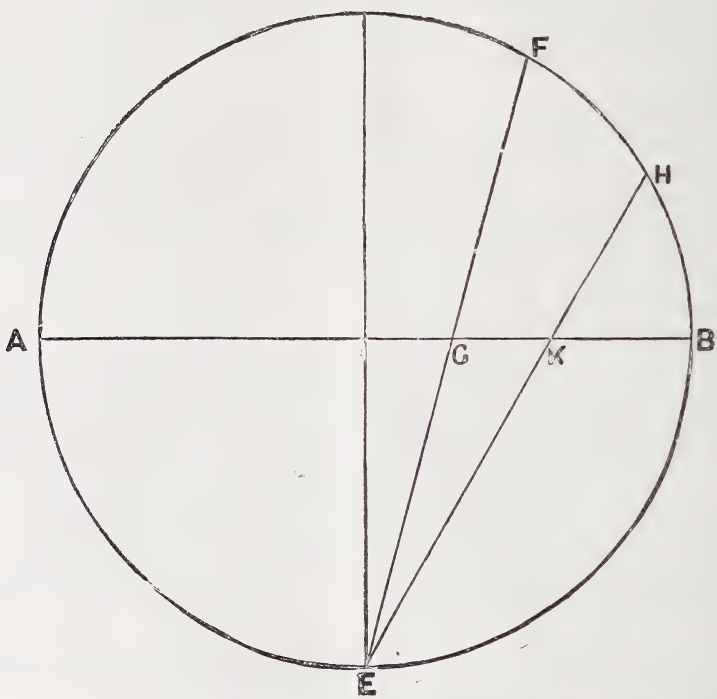


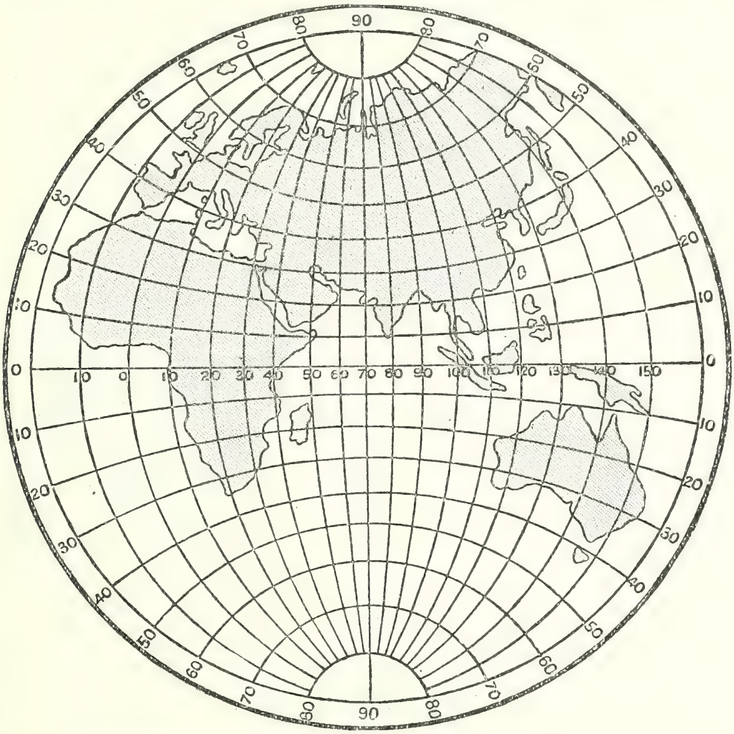
DIAGRAM OF STEREOGRAPHIC PROJECTION.

* All the figures, with the exception of Fig. 4, are from Mr. Morrison's book on "Maps, their uses and construction," and the blocks are kindly lent by Mr. Edward Stanford.

would very nearly fit the corresponding four-sided figure on the map if reduced to the proper scale, but you will notice that while the squares on the globe all along the equator are the same size, those on the map are much larger at the edges than at the centre. It is as if a ruler was represented by a billiard cue. A short piece of one closely resembles a short piece of the other, but in a long length the discrepancy is very great. In spite of its defects this projection is generally looked upon as on the whole satisfactory. It is used in the hemispheres of the *Times* atlas.

The orthographic map is a true perspective picture of the globe, but is unsatisfactory, because of the crowding at the edges. In the stereographic, local shape was well preserved, but relative size was disregarded, the area of a country at the edge of the map being four times as great as that of a similar country at the centre of the map. On the map which I am about to show you all areas are mathematically correct, but shape is slightly sacrificed. You understand, no doubt, what this means. You know, for instance, that a piece of paper 3 inches by 3 inches is the same size as a piece of paper 4 inches by $2\frac{1}{4}$ inches. If you take a number of pieces of paper $\frac{1}{4}$-inch square, you will find that you can place exactly the same number (viz., 144) on each of the larger pieces. Equal size or area, therefore, is independent of shape, and on some equal area projections (because there are many besides the one I am about to show you), shape is sacrificed to such an extent that the countries become unrecognisable.

FIG. 2.



STEREOGRAPHIC PROJECTION OF THE EASTERN HEMISPHERE.

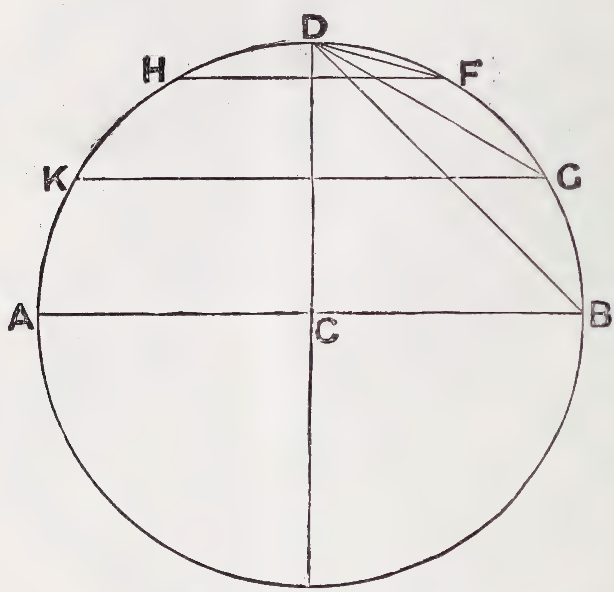
For the benefit of those interested in the mathematical part of the work I shall first show a diagram explaining the construction of the map, from which it will be seen that the distance of any point from the centre of the map is shown by the chord of its angular distance from the corresponding point on the earth's surface, or, in other words, the distances on the map from the centre point are proportional to the sines of half the angular distances on the earth (Fig. 3, p. 556).

The map of the eastern hemisphere, which I now show you, is on this projection, and is taken from Bartholomew's new atlas (Fig. 4, p. 557).

If you wish to measure areas of countries

this projection is, of course, preferable to any other, and for general purposes it is, I think, superior to either of those previously shown. Still, I think for the purpose of teaching geography a projection based not on any distinct mathematical rule, but on a system of compromise is on the whole the best. A map may be made on which the meridians and parallels are spaced at equal distances throughout. Such a map cannot be made by passing wires through paper, and is therefore looked down on by some people as being most unscientific, but it has many advantages. At one time it was largely used in atlases. The hemispheres in the large atlas published by the Society for the Diffusion of Useful Knowledge are on this projection.

FIG. 3.



EQUAL AREA DIAGRAM.

The map on Mercator's projection which I now show you is one with which you are all familiar—in fact, I think much too familiar. People get so accustomed to the appearance of this map that they begin to think it truly represents the globe, and that anything that does not correspond with it is incorrect. (Fig. 5, p. 558.)

You will notice that this map has approximately one property in common with the stereographic map. All the four-sided figures are nearly, not quite, the same shape as on the globe. Those along the equator are square, and they have this advantage, they all are the same size. Those at 60° are twice as long as they are wide, and are all of the same size; thus local shape is well preserved, but comparative size is absolutely sacrificed. You will see that on the globe all the meridians converge towards the pole, while on the map they are parallel—that is to say, a degree of longitude at 60° latitude is shown as large as at the equator, or twice as large as it ought to be; consequently, if *shape* is to be retained the degree of latitude must also be made twice as long as it is on the globe, and you will find that the degrees of latitude get longer and longer towards the pole until they become infinite, and the map consequently has no end.

Now this map is one of the class I mentioned a short time ago. It retains one property of the globe at the expense of disregarding others.

All compass bearings on the map are correct. A compass placed anywhere on the map suits for the whole map. If on the map one port is found to be N.E. of another, then if a ship starts from the second and sails northeast it will reach the first. Curiously enough this will not be the shortest route (as I hope to be able to explain later on), but it is a practicable route, and for moderate voyages is generally adopted.

Now it is worth while to consider what a line

drawn N.E. on the map is like. You see at once that the map may be repeated round the equator as often as you like; indeed this map is repeated for a short distance.

I told you the map continued an infinite distance towards the north pole, consequently a line drawn N.E. upon it will go for an infinite distance in that direction, and will necessarily go right across the world time after time.

Now look at a N.E. line on the globe. At starting it looks simple enough, but no matter how far it goes it never reaches the pole, because the pole is always north of every point and the line has to go north-east, consequently it will go in a spiral round and round the earth always approaching the North pole and never reaching it, and will in fact cut the meridians again and again, exactly in the same way as the straight line in Mercator's map. In spite therefore of the map being flat and the earth being spherical, this *one* property is retained with absolute accuracy.

Before leaving this map I wish you to look at the lines, something like bows with strings which are shown on it. One string goes from London to Shanghai. It lies about E.S.E., and if anyone travels from London continuously along that bearing he will reach Shanghai, the route being across the Caspian Sea. Some few years ago the question of railway communication between Europe and China through North India excited a considerable amount of attention. Naturally the political side of the case was looked upon as the most important, but it is undoubtedly true that many people put aside the physical view of the matter, on the ground that, as the direct line was out of the question, it was immaterial as regards distance, whether one went north through Siberia or South through India. I wish you now to notice the route followed by the bow instead of the string. It goes north of St. Petersburgh and just a little south of the crossing of 80° longitude and 60° latitude. I shall show you in a little that this route is some 500 miles shorter than that along the string.

You may say, how can a curved line be

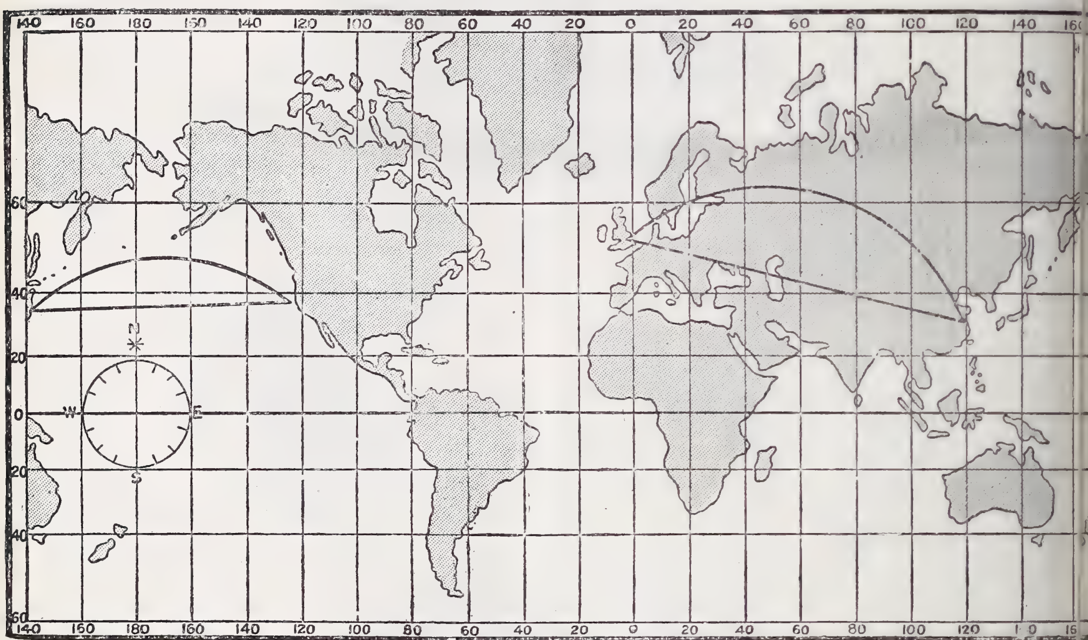
Fig. 4.

Equal Area Projection of Eastern Hemisphere.

shorter than a straight one. I have not said that it is. What I have said is, that the line on the earth represented by the curved line on the map is shorter than the line on the earth represented by the straight line on the map, or in other words, that the ideas of size and relative position given by the map are grossly inaccurate.

I told you that Mercator's projection retained one quality of the globe with absolute accuracy, but I told you at the same time that it did so by utterly disregarding all other qualities. If then you wish for a sailing map for use in navigating your ship take Mercator. If globe. From this it will be clear that the distance of all points from the centre of the map are shown on the map by the tangents of the angular distances of their points from the corresponding point on the earth's surface. It may be here interesting to repeat the principles of construction of some of the projections already considered. Sines give orthographic projection on which a hemisphere may be shown, sines of half angles give equal area on which the whole world may be shown. Tangents give gnomonic projection on which anything less than a hemisphere can be shown. Tangents of half angles give

FIG. 5.



MERCATOR'S PROJECTION.

you wish a map to give you generally correct ideas, banish Mercator's from your mind as being grossly misleading.

stereographic projection on which anything less than the whole world can be shown.

The next map I have to describe is one on what is called gnomonic projection. (Fig. 6, p. 559.) You will remember that for stereographic projection you had to pass wires from the crossings of the parallels of latitude and longitude towards a point on the surface of the globe at the other side.

In this map the wires are directed to the centre of the globe. Under these circumstances the flat surface on which the points are to be projected is placed touching the

Now, I daresay most of you have heard that on a globe a great circle is a circle dividing the globe into two equal portions. Thus on the earth the equator is a great circle, so are all the meridians, but the parallels of latitude are not great circles, they are small circles.

Now a great circle can always be drawn through any two points. It may go at any angle, but it can be drawn. Now, if wires be stuck in along a great circle all pointing towards the centre, they will look like the spokes of a wheel, and a very little considera-

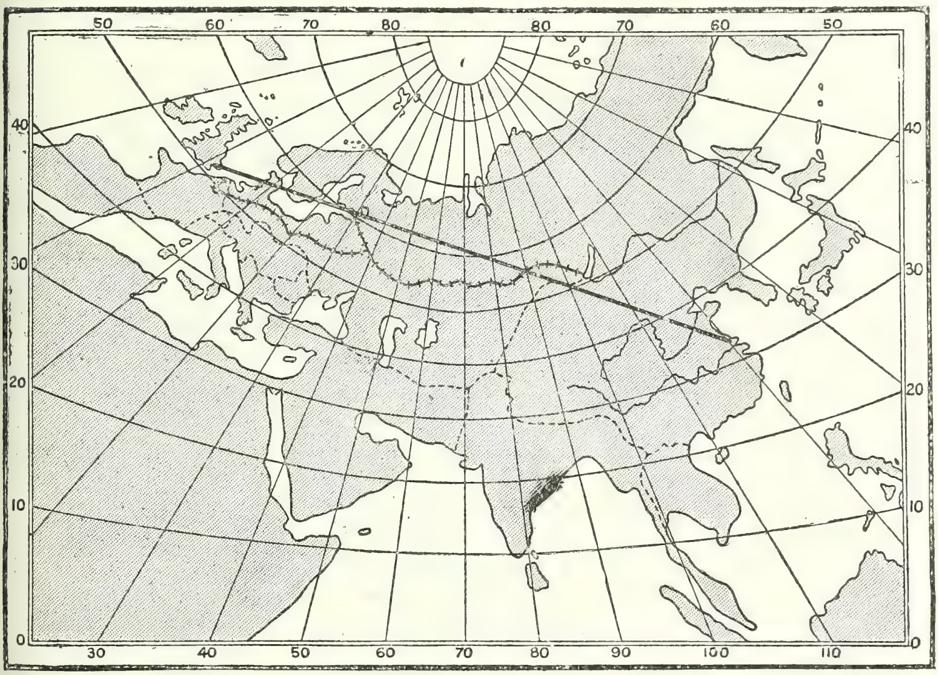
on will show that the points where they strike ny plane will all be in a straight line. Now, iis means that if you make a map on this rinciple, if you wish to find out the most direct nd shortest route between any two points you ave only to draw a straight line between iem.

The map which I now show you is contructed on this principle. It shows Europe nd Asia, and I have drawn on it a traight line from London to Shanghai. 'ou will see that the straight line follows xactly the route traversed by the curved line n the Mercator's, and it now looks as absurd) talk of a direct route lying through the aspian Sea as it did to talk of its going north f St. Petersburgh, when we were looking at Iercator.

The Hydrographic Department of the United tates publish charts on this projection of all ie principal oceans in the world. Such charts re carried by all vessels cruising the Pacific etween Japan and the United States, and I ppose elsewhere.

Great circle sailing was understood in the ays of Elizabeth, and is practised on all good nes now, but in teaching navigation it is treated as if it was an advanced subject. There is no reason for this, and if charts on this projection were common, and if young officers constantly had them before them they would acquire at an early age a more intimate knowledge of the subject than they now possess. A great circle can, of course, be laid down on a Mercator, but on this projection it can not only be laid down more easily, but you see at a glance almost before you draw it, if there are islands or other obstacles in the route, or if too high a latitude will be reached, and a composite route avoiding everything beyond a certain parallel is laid down in an instant just as easily as a complete great circle, simply by drawing lines from the two ports tangent to the parallel in question.

Fig. 6.



Gnomonic Projection.

Now it may be remembered that I said Mercator was a good sailing chart, and you may wonder why I said so, as this seems so much better, and as the United States Government publish the necessary maps. Now I cannot to-night go into the details which make this a poor sailing map, but its true use is to serve for laying down the great circle track, which should then be transferred to a Mercator.

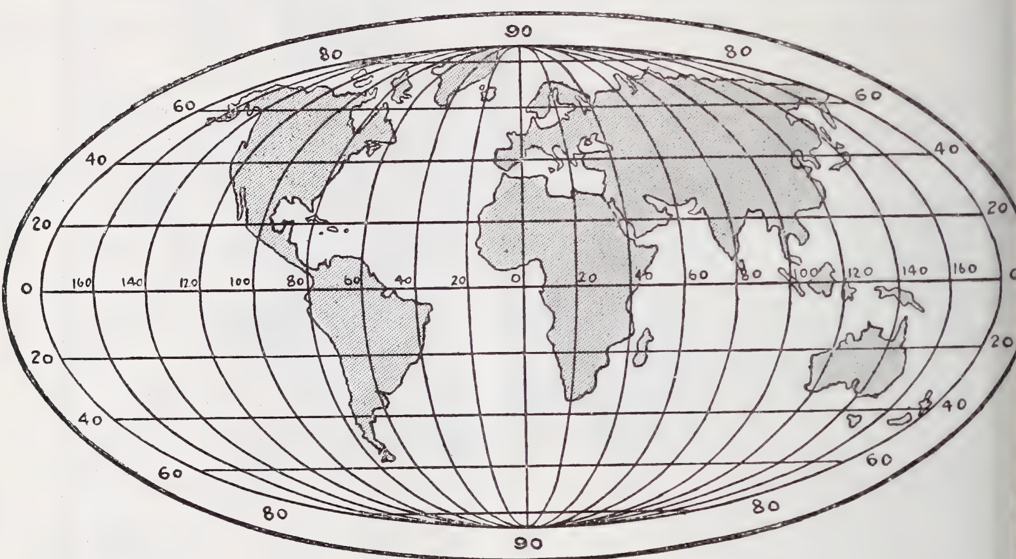
Now, I do not require to warn you against this map as I did against Mercator's, because you very seldom see it, but I say this: if ever you wish to know the direct route between any two places a considerable distance apart ask for this map and see that you get it.

In other words, seeing that maps can be made to retain almost any one quality, when you wish information regarding matters in which that quality is important, try to get the special description of map in which it is retained, but remember at the same time that the one special quality is generally retained by means of an utter disregard for all the others, and one is not far wrong in saying that the best special maps are, as a rule, the worst for general purposes, though it is true that there are some maps which retain some special quality and still have some good general ones.

And now we come to an entirely different class of maps. Hitherto, we have dealt principally with maps which show the entire globe or half the globe, the gnomonic just falling short of half, but one often wants maps of smaller areas. Of course, when one comes to very small maps such as those of London or of one of the counties, the effect of curvature is inappreciable, but if one has to deal with a large country or a continent, it cannot be disregarded. Now you remember that it is possible to make a map retaining one quality at the expense of others, and it is also possible to make a map, one portion of which, generally the centre, is very good, and other portions, generally the edges, very bad. Now in making a map of a country, we have only to consider how that area can best be represented without reference to what would happen if the same principle was applied to a larger area. If, for instance, you want a map of Italy, you consider how best to show Italy, and it is no argument against any special projection that if it were extended so as to show the Cape of Good Hope or Iceland, these places would be badly distorted.

Now I will take away one section of this

Fig. 7.



Elliptical Projection.

globe and replace it by another piece, shaped like a piece of a cone. If you look at this you will see that the amount of distortion is very slight. Of course there is distortion. Neither shape, size, relative positions, shortest route nor compass bearings are exactly correct. On the other hand not one of them is very far wrong, and for most general purposes the error may be disregarded. It will be clear to you that in transferring this surface of the cone to paper there is no further distortion. A piece of paper will lie absolutely flat on any cone and the map can be traced through, or lines of latitude and longitude can be laid down on the piece of paper as they would appear on the surface of a large cone and the map can be drawn in.

This projection, which is called conical pro

jection, is used to a very large extent in atlases for maps of countries, and for that purpose it is as nearly perfect as any projection can be. You will see that on this projection the meridians are straight lines and the parallels are circles. Maps of moderate areas on this projection are so nearly correct that a scale may be used to measure distances.

The map which I now show you is on what is called elliptical projection. (Fig. 7, p. 560.) It is one of the class in which the special quality mathematically retained is equality of areas. What this means I have already explained. Though in some equal area maps the distortion is very great, in this map you at once recognise Europe, Asia, Africa and America, and if the map were on a larger scale you could recognise the various countries, and consequently this map, though a special map, may in the absence of anything better be used for general purposes. Suppose the British Empire and various other empires be shown by distinctive colours on this map, the ideas of relative size obtained by inspection of it are correct, while if this be done on a Mercator the ideas obtained by inspection are most erroneous. For all purposes, therefore, where areas are important, when, that is to say, you wish to compare the number of square miles in one country with those in another, an equal area map should be used, and if the whole world has to be shown I think this is the best.

I think on looking at it one gets the idea that if it was made on a thin sheet of India-rubber it could be fitted to a globe of proper size without much distortion. One, therefore, does not lose the idea that the earth is a sphere, and if maps showing the whole world must be used in schools, I strongly advocate the use of this one. In the map the major axis which represents the equator is twice the minor axis which represents a meridian. The area of the ellipse is, therefore, equal to the area of the surface of a globe whose diameter is equal to $\frac{\text{minor axis}}{\sqrt{2}}$. The major axis is divided into 36 equal parts, and ellipses are drawn through the poles, and the points of division. The crescent-shaped pieces are, therefore, all equal in area, and each is equal to the area enclosed on the globe between two meridians 10 degrees apart. The parallels are straight lines so placed that the area between each and the equator is proportional to the sine of the latitude which it represents, or to the area enclosed between the equator and that parallel on the globe, and the projection is thus a true equal area projection.

What I have said I hope will have shown you, that while maps cannot take the place of a globe, and if improperly used may give very false ideas, still in careful hands they are most useful substitutes. But I hold very strongly to the view that while you want a gnomonic map to lay down long voyages or long railway routes, and an equal area map when you are considering relative sizes of countries, the best maps for general use are those founded on compromise.

The curious mathematical relations of certain projections have such a fascination for those who understand them, that mathematical curiosities are apt to be put in the place of useful projections which have hardly any mathematical properties whatever.

It is of course impossible for the general public to keep copies of maps on all possible projections (as there are very many more than I have mentioned), but this they can always do. They can be on their guard, and if they have the slightest reason to suppose that they are getting false ideas from any map, they can take an opportunity of consulting a globe.

DISCUSSION.

The CHAIRMAN said he was sure they would all thank Mr. Morrison very much for the lucid way in which he had put a difficult subject before the meeting. The subject was not an easy one for people who had not studied it before. With regard to modern maps, he quite agreed with Mr. Morrison that there was a tendency to crowd things very much, but still he thought that the advance that had been made during the last twenty years in atlases was most astonishing. Anyone who looked back at the maps of thirty years ago would see an astounding difference. The number of atlases which existed showed, he hoped, an increased interest in this country sufficient to make it worth the while of map publishers to produce so many atlases. He proposed to refer to Mercator's projection, or rather to Mercator in relation to the gnomonic projection. Mr. Morrison was very kind to him (the Chairman) personally, in not pressing home a little more the fact that the English hydrographers had not published any gnomonic charts, whereas the United States had published them. He had had it in his mind a good many times to publish gnomonic charts, but on making inquiries he had found that the occasions on which such charts would really be of any use would be very few, and that there was a pressing demand for other charts. But there were many charts waiting in his book for publication, when there

were engravers to engrave them, and money to produce them. As a matter of fact, there were very few parts of the world in which the great circle sailing, pure and simple, could readily be carried out to very great advantage. There were one or two places, but they were so very well known that it was not at all necessary to have a gnomonic chart for them. He thoroughly agreed with what had been said as to the beauty of the gnomonic chart, and if it could be brought out without putting something more urgent in the background they would have had gnomonic charts before now. There was a use in the gnomonic projection which Mr. Morrison did not mention, and that was that every survey that was made of a considerable area of the earth in which the curvature came in must be gradulated or have lines of latitude and longitude drawn upon it on the gnomonic projection in order to transfer it to any other projection. Every survey was made on the gnomonic projection whether there were lines of latitude and longitude drawn or not. If they were making the plan of a field they did it on the gnomonic projection though they might not know it. The elliptical projection that Mr. Morrison showed was a very nice one, and he believed for educational purposes Mr. Morrison regarded it as the best projection. Perhaps as far as the map went it was the best, but he was bound to say that he thought for educational purposes there was nothing like the globe. He was very sorry to have seen the use of globes being put so entirely on one side. What used to be called "The use of the globes," was an extremely useful study, and fifty years ago, people knew a great deal more about the movements of the earth and the movements of the heavenly bodies than they did now, because they were taught what was called the use of the globes. At the same time, for a small child the use of a mounted globe with a horizon and meridian around it, was rather confusing. What he should like for that purpose, was an absolutely loose globe. This cost only one-third of an ordinary globe, and he had tried very hard to get people to use loose globes at schools. The worst of it was, that a loose globe was so easy to move, and schoolboys might use it as a football. But for the teaching of the children, there was nothing like it. When a loose globe was used, it was astonishing how they could understand both the shape and the size of the different countries, and the way in which the world would turn round. He agreed also with Mr. Morrison, that arbitrary projections all things considered, were the best. All the mathematical projections had got one defect or another. An arbitrary map often combined the advantages of one projection with the advantages of another. The conical projection was very good for small areas.

Major C. F. Close, referring to arbitrary maps said that they had Airy's projection for a good many years. It was a thoroughly well understood projection, and it would give the minimum of error. He did not see why the map makers should not take Airy's projection instead of taking, as they did, a arbitrary scale. He did not think that there was single atlas in the world where Airy's projectio was used.

Lieut.-Col. Allan Cunningham said that h wished to make one or two historical remark The first was with regard to the learning the use of the globes which had been referred by the Chairman. He remembered that yea ago girls' schools used to announce "Mapping an the use of the globes taught." He did not see th announcement any longer. It was stated in the pap that one seldom saw a globe more than 2 ft. 6 in. diameter. Some 40 years ago there was a very b globe in Leicester-square, which must have bee something like 60 ft. in height. That globe had very great peculiarity. It was not like an ordina globe, but it was a globe in which the geographic features were shown on the interior of the ball. T countries and the mountains were shown in reli Persons went inside the globe, and there was a sta case in the interior by which they could ascend fr the South to the North. They saw the countri from the inside just as if the shell of the globe w transparent, and they could see through it. H should like to ask Mr. Morrison whether he cou tell the meeting anything about an old projecti which he (the speaker) took some interest in. H thought that it must have been Sir Henry Jame projection. Two-thirds of the globe were plott at once on the same semi-circular area. Rath less than one third of the space near one pole w occupied by a series of ellipses representing t parallels all round the pole, and then the rest of t hemispheres over and above those circles right rou the pole came on the rest of the map, so that the was more than a hemisphere, which one would thi was an impossible thing.

Prof. J. D. Everett, F.R.S., said that he thoug Mr. Morrison was doing a most useful public service calling attention to the qualities of the different m projections. The subject was not nearly so w known and understood as it ought to be. Tho persons who wished to understand it better would well to get a small book which Mr. Morrison h published in which the information he had given t night was included. He thought that the selecti which Mr. Morrison had made to-night in his pap was extremely judicious. There were a great ma equal area projections; but the elliptic whi he mentioned last was one that was largely owi to Mr. Morrison himself. He believed that M Morrison was the first man that made a map of t world upon the elliptical projection. It was exac an equal area projection, and there was less distortio he believed, than in any other equal area projecti that had been devised. He heard Mr. Morrison e plain the gnomonic projection at the British Associ

ion many years ago, and he was very much impressed vith the remarkable property which it possessed of epresenting every circle as a straight line. He hought they ought to have maps of large regions of the earth and the sea on that plan, so that they could be referred to occasionally to correct people's deas. He agreed with Mr. Morrison that, for general purposes, there was nothing to beat what was sometimes called the globular projection. He objected to ts being called *the* arbitrary projection, because there were many other arbitrary projections; but it represented an extremely judicious compromise, It was n general use when he was a boy at school, and he rusted that it would not be allowed to drop.

Mr. MORRISON, in reply, thanked those who had taken part in the discussion, for speaking so kindly of what he had said. He could not take the credit of being quite the first person to make a map on the elliptical projection. That projection was found fully prescribed in Germain's book on map projection, but it was very little known, and he had done what he could, during the last year or so, to impress the good qualities of the elliptical projection upon some of the map publishers, and he hoped that he had done so with good effect. A question had been asked with regard to James's projection, and projections of the same class as Airy's. Perhaps it was wrong to say that they were exactly the same, but they looked the same. The orthographic projection which he had shown, was the perspective of the globe seen from a great distance; perhaps an infinite distance. The stereographic projection was really a projection of the globe seen from a point on the surface. The gnomonic projection was a projection of the globe seen from the centre. James's projection was a perspective of the globe seen from a point outside, and not at a very great distance, and it showed not the side of the earth next the observer, but the far side, as it would be seen through the earth, if the earth were made of glass. Consequently, it took two-thirds of the sphere. It was a very beautiful projection. Major Close's reference to projections of least error, of course, he quite agreed with. Those projections were magnificent, and he should like to see them more used, but it was very difficult to explain them in a popular manner on an occasion of this sort. He remembered the globe in Leicester-square. Of course, he entirely agreed with the Chairman with regard to the use of globes. For educational purposes, nothing could touch a globe. There was no comparison between a globe and a map in that respect. But there were cases in which it was extremely difficult to do certain things with a globe, even in the matter of education. A teacher had sometimes to speak of the earth to a large class of children, and a globe would be too small for them all to see. In that case the teacher was almost driven to make use of a map. He thought that if the whole earth had to be shown on one sheet the elliptical projection was quite as good as any other. He understood the Chairman's position with regard to the gnomonic projection, and he thought the Chairman was quite right. There were very few occasions on which that projection could be used. All the great lines of vessels ran on definite routes from port to port. Either to avoid ice or possible collisions, or for some other reason, their routes were fixed, and those routes were followed as a rule time after time. He could not help thinking, however, that the senior men in the service understood the system so well that they hardly knew now difficult the subject was for junior men to learn. He still thought that if the junior men could have had the gnomonic charts when they were boys, and got them into their heads, it would be a good thing for the service. In all voyages some route must be taken as a basis. A man did not go to sea and wander about until he came somewhere. The great circle route was the proper basis, and he thought that the younger men would get the whole idea of great circle sailing earlier if gnomonic maps were constantly about. He quite agreed that there was an enormous advance in atlases. The difficulty of which he spoke with regard to the crowding of information on one single sheet seemed to be the effect of an endeavour to keep down price by putting different features on one map instead of having different maps for physical features, political divisions, and so on. He thought that maps would be better if something were left out. If people could not afford separate maps for the different features which had to be shown, less should be put upon one map, because nine people out of ten got so confused with a crowded map that they could not grasp what was shown.

The CHAIRMAN said that he would add only one remark to what he had already said. Mr. Morrison's way of describing the gnomonic projection was, he thought, most admirable. It was a difficult projection to describe. By means of the sheet of card laid against the globe and the lines drawn from the centre the gnomonic projection was described extremely well. He would ask the meeting to accord a hearty vote of thanks to Mr. Morrison.

Obituary.

ABRAHAM FOLLETT OSLER, F.R.S.—Mr. Osler, the eminent crystal glass manufacturer, of Birmingham, died at Edgbaston on Sunday, 26th April, at the advanced age of 95. He was particularly interested in meteorological study, and devised a self-registering anemometer, respecting which he wrote several papers. He was elected a Fellow of the Royal Society in 1855, and a Member of the Society of Arts in 1877.

Correspondence.

AUTOMATIC COUPLERS.

It would add much to the value of Mr. Brockelbank's interesting paper if he could give the number of the various shunting operations in America, with their large truck-full loads and long journeys, compared with the number in Great Britain, with their small truck-half loads, and short journeys of the British railways. By this means a true comparison can be got at of the number of killed and injured in the accidents due to shunting, even with Mr. Brockelbank's automatic coupling. The lever has to be moved every time it has to be uncoupled. It is the crossing and re-crossing of the rails to the various sidings while shunting is proceeding that causes the various accidents, in the shunters being knocked down and run over by engines and trucks. This would go far to answer Colonel Cunningham's question as to the appalling number of accidents, as the shunting operations are much more numerous here than in America. T. R. CHALMERS.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evening, at Eight o'clock :—

MAY 13.—"Preservation of Big Game in Africa." By E. NORTH BUXTON. SIR JOHN KIRK, G.C.M.G., K.C.B., will preside.

MAY 20.—"Fencing as an Art and an Historic Sport." By EGERTON CASTLE, M.A.

INDIAN SECTION.

Thursday Afternoon, at 4.30 o'clock :—

MAY 14.—"The Province of Assam." By SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D. The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M P., will preside.

APPLIED ART SECTION.

Tuesday Afternoon, at 4.30 o'clock :—

MAY 19.—"Mezzotints." By CYRIL DAVENPORT, F.S.A. SIDNEY COLVIN, M.A., Keeper of Paints and Drawings, British Museum, will preside.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

W. WORBY BEAUMONT, Mem.Inst.C.E., "Mechanical Road Vehicles." Four Lectures.

LECTURE III.—MAY 11.—Types of vehicles made, 1900 to 1902—Improvements—Increasing popularity of the internal combustion petrol motor—Steam and its uses—Growth of motor power—Electrical vehicles —Carburettors—Coolers—Fuel economy—Automobile Club trials—The Gordon Bennett race.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 11...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. W. Worby Beaumont, "Mechanical Road Vehicles." (Lecture III.)

United Service Institution, Whitehall, S.W., 3 p.m. Mr. J. M. Rogan, "Military Bands and Military Music."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. L. Gowing, "In Dickens Land."

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, MAY 12...United Service Institution, Whitehall, S.W., 3 p.m. Mr. P. Randall, "The Disposal of the Wounded in Naval Warfare."

Asiatic, 22, Albemarle-street, W., 3 p m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. G. H. Darwin, "The Astronomical Influence of the Tides." (Lecture I.)

Medical and Chirurgical, 20, Hanover-sq., W., 8½ pm.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. Howard Farmer, "An Improved System of Portraiture."

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. James F. Gemmill, "A Contribution to the Study of Double Monstrosities in Fishes." 2. Mr. Robert Gurney, "The Metamorphoses of *Ægeon fasciatus* and *Ægeon trispinosus*." 3. Mr. Martin Jacoby, "Descriptions of new Species of South American Coleoptera of the Family *Chrysomelidæ*.

Colonial Institution, Whitehall-rooms, Whitehall-place, S W., 8 p.m. Mr. H. G. Parsons, "Our Colonial Kingdoms."

WEDNESDAY, MAY 13...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. E. North Buxton, "Preservation of Big Game in Africa."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Geological, Burlington-house, W., 8 p.m.

Japan Society, 20, Hanover-square, S.W., 8½ p.m. Mr. T. Hamaguchi, "Some Striking Female Personalities in Japanese History."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

Society for the Encouragement of Fine Arts, 6½, Suffolk-street, Pall-mall, S W., 8½ p.m. Second Conversazione.

THURSDAY, MAY 14...SOCIETY OF ARTS, John-street, Adelphi, 4½ p.m. (Indian Section.) Sir James Charles Lyall, "The Province of Assam."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. Sidney H. Vines, "Proteid-Digestion in Plants." (Lecture I.)

Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. 1. Mr. A. D. Williamson, "Applications of Electricity in Engineering and Shipbuilding Works." 2. Adjourned discussion on Mr. A. B. Chatwood's paper, "Electric Driving in Machine Shops."

FRIDAY, MAY 15...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. D. H. Scott, "The Origin of Seed-bearing Plants."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper on "Lead Work."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, MAY 16..Royal Institution, Albemarle-street, W., 3 p.m. Mr. Hamish MacCunn, "Music." (Lecture II.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, May 18, 8 p.m. (Cantor Lecture.) W. Worby Beaumont, M.Inst.C.E., "Mechanical Road Vehicles." (Lecture IV.)

Tuesday, May 19, 4.30 p.m. (Applied Art Section.) Cyril Davenport, F.S.A., "Mezzotints."

Wednesday, May 20, 8 p.m. (Ordinary Meeting.) Egerton Castle, M.A., "Fencing as an Art, and as an Historic Sport."

Further details of the Society's meetings will be found at the end of this number.

EXHIBITION OF BRITISH ENGRAVING AND ETCHING.

The private view of this Exhibition was held at the Victoria and Albert Museum, South Kensington, on Thursday, 14th inst. This is the third of a series of Exhibitions of the Graphic Arts arranged by the Board of Education, and owes its initiation, like those of "Lithography" and of "Modern Illustration" held on former occasions to the Council of the Society of Arts. The original proposal was to exhibit all methods of *intaglio* engraving, including photogravure and other mechanical processes, but on the suggestion of the Advisory Committee the Exhibition has been restricted to Fine Art Engraving and Etching, and the Exhibition of Photographic Processes of Engraving has been reserved for a future occasion. In addition to a fine collection of Line Engravings, Mezzotints, and Etchings from the earliest to the present times, there is shown a series of tools and materials used in etching and engraving.

VIVA VOCE EXAMINATIONS IN MODERN LANGUAGES.

The following is a list of the *Vivâ Voce* Examinations which have been held this year by the Society :—

Subject.	Place of Examination.	Date.	Number of Candidates.	Passed.	Failed.
French	Birkbeck Institution, E C	April 8	28	19	9
Do.	Manchester School Board	,, 27	22	16	6
Do.	Queen's-road School, Dalston (London School Board)	,, 29	27	21	6
Do.	City of London College, E C. .... (Examination arranged by Technical Education Board of the London County Council.)	May 4	22	18	4
Do.	Battersea Polytechnic, S.W. .... (Exam. arranged, &c., as above.)	,, 5	29	21	8
German	Regent-street Polytechnic, W.	April 20	19	10	9
Do.	Queen's-road School Dalston (London School Board)	,, 27	19	14	5
Do.	Manchester School Board	May 4	11	7	4
Do.	Battersea Polytechnic, S.W. .... (Exam. arranged, &c., as above.)	,, 7	10	9	1
Do.	City of London College, E.C. .... (Exam. arranged, &c., as above.)	May 11	25	12	13
Spanish	Manchester School Board	April 30	11	7	
Do.	City of London College, E.C. .... (Exam. arranged, &c., as above.)	May 8	8	6	2
Portuguese	Manchester School Board	April 28	20	18	2
			251	178	73

The Examiners were Mr. E. L. Naftel for French, Professor H. G. Atkins, M.A., for German, Professor Ramirez for Spanish, and Mr. J. d'Oliveira e Silva for Portuguese.

CANTOR LECTURES.

On Monday evening, 11th inst., Mr. W. Worby Beaumont, M.Inst.C.E., delivered the third lecture of his course on "Mechanical Road Vehicles."

The lectures will be printed in the *Journal* during the autumn recess.

INDIAN SECTION.

Thursday afternoon, May 14, 1903; The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M.P., in the chair.

The paper read was "The Province of Assam," by SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D.

The paper and report of the discussion will be published in a future number of the *Journal*.

Proceedings of the Society.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 13, 1903; SIR JOHN KIRK, G.C.M.G., K.C.B., M.D., D.Sc., in the chair.

The following candidates were proposed for election as members of the Society:—

Balasubramanyan, N., M.A., Purasavakam, Madras, India.
Barton, James, Exchange-buildings, Dundalk, Ireland.
Betham, George Keys, 20, New Clive-road, West Dulwich, S.E.
Brackenridge, George Washington, San Antonio, Texas, U.S.A.
Carrington, John Bodman, 14, Netherhall-gardens, Hampstead, N.W.
Clark, Theodore Minot, 22, Congress-street, Boston, U.S.A.
Humley, Henry George, M.Inst.C.E., 39, Victoria-street, S.W.
Le Bas, Edward, 2, Glebe-place, Clissold-park, N., 18 Billiter-street, E.C., and Cyclops Works, Millwall, E.
Pope, William Hughes, Belle Vue, Folkestone.
Southon, Thomas Alfred, Broedersdraai, Haenertsburg, Transvaal, South Africa.

The following candidates were balloted for and duly elected members of the Society:—

Hippisley, Colonel Richard Lionel, R.E., C.B., 39, Grosvenor-road, Westminster, S.W.
Hughes, H. G., 30, Bread-street, E.C.
Kinley, Prof. David, Ph.D., University of Illinois, Urbana, Illinois, U.S.A.
Leslie, Thomas Nicholas, F.G.S., P.O. Box, 23, Vereeniging, Transvaal, South Africa.
Power, Frederick Belding, Ph.D., 6, King-street, Snow-hill, E.C.
Price, Matthew Burn, F.R.I.B.A., 254, Longmarket-street, Pietermaritzburg, Natal, South Africa.
Reynolds, H. H., M.I.E.E., 4, Fairlie-place, Calcutta, India.
Spier, William, Mansfield-chambers, Quay-street, Rockhampton, Queensland, Australia.
Rose, George B., Messrs. Rose, Hemingway and Rose, Little Rock, Arkansas, U.S.A.
Rose, George Edwin James, Messrs. Butterfield and Swire, Wuhu, China.

The paper read was—

THE PRESERVATION OF BIG GAME IN AFRICA.

By E. NORTH BUXTON.

It is a melancholy fact that our boasted civilisation generally brings in its train the destruction of wild life in the countries we occupy. In opening up a virgin territory, it is the game hunter who is most often the pioneer. He is followed in order by the missionary, the mining prospector, and the protectorate officer, all of whom take toll of what is left, till by the time there is a settled population and a stable government, little remains of that which gives the charm of life to the wilderness.

It is high time that the efforts being made in many British colonies and protectorates to arrest this deplorable waste, should be vigorously supported at home. Much has been done in the past decade, and the officials of the great departments of State—the Foreign Office, the Colonial Office, and the India Office, as well as many of those on the spot, are fully alive to the urgency of the case, but unless their efforts are backed up by a strong and healthy public opinion at home, I fear that they will be ineffective as against the "game hog." I borrow that expressive phrase from our American cousins, who have suffered in their territories also by the depredations of the creature, and are much exercised how to keep him in subjection. In case any of you have not met with a specimen of this predatory animal, I may mention that he is distinguished by callousness, and a passion for destruction when excited. He is generally very young, and is apt to boast of his long shots, a proceeding which invariably ends in leaving wounded animals behind him. Doubtless many of those, whose actions I criticise, afterwards learn self-restraint, and become good sportsmen. Perhaps we have all suffered from this youthful epidemic. I had it myself, but recovered early. Well I remember returning from a marauding expedition, soon after I obtained my first gun. I was laden with a varied bag of tomtits and chaffinches which I

had shot sitting. The scorn with which my tiny trophies were handled by an indignant parent was never forgotten. My cure was painful but rapid.

Of course, man, the destroyer, has always been at his work, but his power has enormously increased, and should be tempered by mercy. If you compare the weapons of old with modern arms of precision, you will understand the ever-increasing rate at which the depletion of life goes on. What was the primitive way? I call an eye-witness of 100 years ago:—

"By means of signals from natives posted on high, an immense concourse of men and dogs were speedily assembled near the deep and bushy ravine in which the elephants had taken refuge. The clamour of the naked hunters, reverberated by the precipices, became tremendous. I was frequently constrained to tremble for the safety of the pursuers whilst witnessing their fearless advances towards the huge and irritated victims, seeing that their slender lances constituted the whole of their armour. To see them, in a state of perfect nudity, boldly proceeding to within reach of one of these powerful brutes, could not but give rise to the most serious apprehensions. Three out of the number were at length brought to the ground, and several others severely speared."

You will understand that from such a contest there were plenty of survivors. Now skip half a century and listen to this by way of comparison. By that time the power of the rifle had begun to be appreciated, and the favourite weapon was a two-groove rifle, and a belted spherical bullet:—

"I crawled in and came upon a kind of backwater from the main river, 150 yards long by 50 wide, with high banks, especially the one opposite me, on which sat dear old ——— blazing away right merrily. 'What is it,' I shouted. 'Look at those beasts,' he replied. Bang! 'There again.' The pool was alive with monstrous heads, and though this was the first time I had seen the hippopotamus in the flesh, there was no mistaking him. I opened fire at once from my side, at heads which showed for a second above water. Nothing came of it. Though the hippopotamus were hit every time, not one of them seemed to die. No results of the thirty or forty shots that had been fired, and yet the animals were within twenty or twenty-five yards of us. 'Have you killed any, old fellow,' I shouted, and the answer came back to me, 'No,' but I have hit all I fired at.' The evening was closing in. One hippopotamus floated up dead on ———'s side. Next morning, however, on the surface lay fourteen huge bodies."

Now come to quite recent times. When in Vienna not long ago, I saw, at the taxidermists, the bag of a sportsman just returned from Somaliland. Among other things there were seventy heads of Soemmering's gazelle. What can one man want with seventy specimens? But the remarkable thing about them was, that most of them were females or immature males. To anyone knowing the habits of this species, which feed in large herds on the open plain, where they may be readily approached to within three or four hundred yards, it was perfectly evident that these had been obtained by shooting into the brown at about that distance—a very easy thing with a modern small bore rifle, but hideously destructive and cruel.

It is the invention of smokeless powder and small bore bullets which marks this latest advance in destruction. Their enormous speed and penetration, and the absence of recoil, make fine shooting easy, even to a beginner, while the lightness and cheapness of cartridges tempt the novice to carry a number and to fire them away at long ranges. I wish to urge on all sportsmen that it should be one of the unwritten laws of the game that small bore bullets, that is ·303 or less, should not be used on animals larger than a fallow buck. We know by recent experience that such bullets mortally wound without stopping even men, much less animals three or four times their bulk. Even in the hands of first rate shots the suffering is prolonged. These improvements have revolutionised war and enabled a small and backward people to hold at bay a powerful empire. What wonder if it gives the greedy sportsman an undue advantage.

I am here to-night to try and focus and unite the growing public sentiment in favour of the restriction of the energies of that class of sportsmen, whose thoughtlessness has been responsible for such terrible destruction.

I cannot do better, I think, than concentrate your attention for a few minutes on the marvellously rich fauna of South Africa a century ago and compare it with the state of things at the present day. I wish to show you how this pitiful waste has taken place by a policy of *laissez faire*, and point out the best manner, as I conceive it, in which we may yet save a remnant for future generations in other British possessions if not there. I shall have to illustrate my point by a few quotations, as that is the best way to mark off the stages of this "rake's progress."

Here is an old calf-bound book given to me by my grandfather 54 years ago, which had lain for a similar period on the family bookshelf. I may be excused for reverting to it as I imbibed from it my first love of the

wilderness. It is a translation of the Travels of M. Vaillant, a Frenchman, in 1780. He trekked out from the Cape, and thus describes what he saw in the near neighbourhood :—

"In the space of four leagues," he says, "we had on all sides very near us gazelles, bontibocks, bubales, with numbers of zebras, ostriches, &c. My dogs eagerly pursued these creatures, who mingled as they fled and altogether formed one vast herd, but the moment I had called off my dogs, and they thought themselves out of danger, each different species composed a separate band, and kept at a certain distance from each other. I could have shot numbers of them from my waggons, for they were very tame, and seemed pleased to gaze on us."

He also notices the blue buck, which has now passed for ever, and immense herds of buffaloes and elephants, "so amazingly numerous that we thought it inadvisable to dispute their passage, my camp animals and carriages would have been pulverised in a moment." Even at that period the unnecessary slaughter of wild animals had excited attention. The Swede Sparrman wrote, in 1786, of "sportsmen who merely for the pleasure of shooting are guilty of wasting the treasures of nature in a most unjustifiable manner, and thus spoil their own sport as well as that of others. For when," he says, "they make a hunting expedition they seldom or ever return from the pursuit of a herd of game before they have made a great havoc among them, though the carcasses are afterwards left to rot on the ground."

It was, however, well into the 19th century before the worst slaughter began. From year to year improved communications, the repute of those who had gone before, and better weapons, tempted fresh adventurers into the wilderness. Gordon Cumming was one of the pioneers. In my youth I regarded him as a hero, as did many others. I have somewhat altered my opinion. Here are specimens of his practice taken at random :—

"I wounded a white rhinoceros, but did not follow it. As we held up the side of the river I killed a very fine old black rhinoceros, and cutting off his horns rode home [that is, leaving to waste meat enough to feed a village]. In the course of the day I saw the fresh spoor of about twenty varieties of large game, and most of the animals themselves, namely, elephant, black, white, and long-horned rhinoceros, hippopotamus, cameleopard, buffalo, wildebeest, zebra, waterbuck, sassayly, koodoo, pallah, springbuck, boar, dinker, steinbuck, lion. Besides the game which I have noted, the following are not uncommon—eland, oryx, roan, sable antelope, hartebeest, klipspringer, and others."

In recording the death of his fiftieth bull elephant he adds the words "not to mention numbers lost," as if that were something to his credit. Indeed, it would seem that the numbers lost were almost equal to those secured.

Thirty years later most of the Cape Colony was denuded of game, but Oswell, Livingstone, and others still found vast herds beyond the Orange River. Near the Matopo River, Oswell describes—"Seven different kinds of animals within view, some, especially the quaggas and buffaloes, in large herds, springbucks, hartebeest, gnus, &c., filling in the picture; together there could not have been less than 3,000." Of these the quaggas are completely extinct, and the mountain zebra, a most graceful animal, nearly so. Here is an account of another of the beasts which have perished — the white rhinoceros. "Poor stupid old fellow," he says, "too quiet as a rule, though when thoroughly upset, reckless; he was just the very thing for young gunners to try their prentice hand on." You see young gunners must have something to blood themselves upon which is too clumsy to get away—just as you draw the teeth of rats when you are entering a young terrier to them.

A much more valuable world's asset at this time than the rhinoceros or hippopotamus were the elephants. Oswell, in 1850, describes seeing, near Lake Ngami, 400 elephants standing drowsily in the shade of the detached clumps of mimosa trees as far as the eye could reach in a fairly open country—"There was nothing but elephants. I do not mean in serried masses, but in small separate groups."

But the sad story of elephant slaughter during the 19th century should be examined a little more in detail. Not only has a valuable and productive asset been thrown away, but the possible use of the elephant as a friend and servant of man has been sacrificed. To what purpose was this waste? The herds were abundant throughout Cape Colony at the end of the 18th century, when Barrow, a secretary to the Governor, records a troupe of 400 having been seen in the neighbourhood shortly before. It is probable that up to then, and perhaps for twenty years later the elephants suffered no great diminution except from the traditional methods—pitfalls and spears—of the natives. But by 1830 they had thinned out, and the ivory hunters had to go further afield. When the Boers crossed the Orange River they opened out a vast ivory-bearing territory, and great numbers of hunters took

to elephant hunting as a profitable profession. Who can blame them? They had to live, and a rich field lay open to the bold pioneer who feared neither savage nor wild beast. If blame must be allotted, it is to the rulers who recked not of the slaughter going on. The hey-day of the hunters lasted for 50 years. In 1836, Capt. Harris found hundreds of elephants in the Magaliesberg (close to Pretoria), where a sterner kind of hunting has lately familiarised us with those pastures. The next move took these brave wanderers to the Zambesi and far to the west. At an ever-increasing rate the inroads on the herds continued, until what drought or pestilence, or native persecution had never effected, the modern rifle has completed, and now south of the Zambesi, a mere fraction of the former number remains. Only a few miserable hunted remnants, just as I remember in 1884 in America, the last solitary wanderers of the bison were being shot down by cowboys, their very rarity making them ten times as valuable as a trophy. One slight exception must be mentioned. Owing to the foresight of a few individuals, a small sanctuary was established in the Knysna forest near the coast in Cape Colony, which was, perhaps, the forerunner of all the game reserves now existing. It is estimated that there are 60 elephants left in it, and for a sum of £10 I believe you or I may go and shoot one. The pity of it is, that such an experiment was not attempted on a larger scale and long ago in many a fair range of mountains in Mashonaland and the Transvaal. There were not wanting among the Boer farmers, enlightened men who did what they could to preserve some of the disappearing species of antelope on their own farms, as for instance the white-tailed gnu, the bontibok and blesbok. It is to be feared that the rough work which accompanied the drives for De Wet have left but a miserable remnant, even if this species are not entirely extinguished. I rejoice to know that under Lord Milner's enlightened rule several reserves have now been established in those States and in Cape Colony, so that something may be saved. It is a suggestive fact that the chief, Lobengula, had a reserve for elephants in which it was death for anyone to hunt, and another for hippopotamus. When that chief went down it was white men who instantly devoured the whole. It is singular that this savage potentate should have had more foresight than the civilised beings who ousted him.

Unhappily the same story is being repeated as regards elephants in Central Africa, notably in the upper waters of the Congo the destruction proceeds apace. The method of the Belgian is to squeeze the orange dry at the earliest possible moment. But everywhere the hand of man is against the elephant. From their wandering habits it is to be feared these animals derive but little protection from the smaller reserves. The International Congress, which assembled in London in 1898 to consider this question, agreed upon certain recommendations to their respective Governments, but these appear to have been chiefly honoured in the breach except by ourselves.

Coming further north, I have known of one Englishman who destroyed 30 of the small remnant of elephants in the British Protectorate of Somaliland. These were all females or immature males. It is not surprising that they have now disappeared from that protectorate. They are rapidly diminishing in those regions of Abyssinia which adjoin it, and, it is to be feared, in the Soudan also. A French newspaper celebrates the prowess of a certain count. It is headed "Four Elephants in Four Minutes," and, the photograph, which accompanied the article showed that they were all cows or calves.

By way of indicating the diminution even in recent years I have tried from such returns as I could get access to, to arrive at the figures of the exportation of ivory from various African colonies, and selected what appeared to be most important in this respect. It will be seen that in these cases, at any rate, there is a steady decrease. From the Cape we find the value of this export in 1887 was £16,358, in 1901 it was £567. From Natal the export of £18,170 worth in 1857, was reduced in 1897 to £79. Lagos in 1867 had an export of £6,309. In 1901 it was reduced to £827. Coming to recent times in British Central Africa the value exported diminished from £18,252 in 1895 to £543 in 1902. From Zanzibar in 1891 ivory to the value of £544,818 was exported; seven years later it was reduced to £112,914. From the Congo Portuguese territory, the export of 10,982 kilog. in 1889, was reduced to 1,600 kilog. in 1898. From German East African possessions the value of exported ivory in 1892 was 2,439,000 marks; five years later it was only 1,495,000 marks. Only in the Congo Free State the supply seems to be at present maintained, but I fear by methods which will only too surely bring an end. There is reason to believe that a feverish pressure is

maintained from Brussels on the officials, who impose an ivory tribute on the unfortunate natives. Notwithstanding the international prohibition, "scrivelloes," that is small tusks, valuable for billiard balls, still come into the market. The annual importation of ivory into this country is still about 11,000 cwt., which according to my calculation represents at least 30,000 elephants destroyed each year.

But I have said enough of the deplorable prodigalities of the past. It is to be hoped that this Empire, whatever others may do, has sown its wild oats, and will husband its resources in the future. Under the instigation of the Foreign Office every British protectorate in Africa now has a series of ordinances for the preservation of wild animals and birds. They are mainly framed on the same model, but with some differences to suit the varying conditions. Certain specified areas are declared to be game reserves. Licenses must be taken out for a considerable payment in the case of strangers, and a much lower one for public officers or settlers. In most of them certain species of the larger game are altogether protected. Of the remaining animals the license specifies how many of each may be killed. As regards the commoner species they are generally divided into two categories —of the larger and slow-breeding animals, such as elephants, buffalos, or the greater antelopes, as a rule, only two are allowed to each sportsman, while of the commoner kinds, such as lesser antelopes, ten may be killed. Heavy fines are enacted for offences against these regulations. Heads, horns, and skins, are not allowed to be exported. Every license holder is required to keep a register of the animals killed by him, and to submit this to the resident officer at the expiration of his license, or on leaving the territory. Any elephants' tusk weighing less than eleven pounds, if found in the sportsman's possession, and all cow ivory, is confiscated. The use of dynamite or poison for the taking of fish is forbidden. Now these regulations are all good, and provided they are effectually enforced they should go far, if not to prevent the diminution of the game, at least to save the species from extermination.

Of these regulations, by far the most important which can be adopted by the executive government of any territory as a practical measure for the preservation of species is the constitution of an adequate sanctuary.

Let me endeavour to describe some of the conditions which should be observed in the selection and delimitation of such a reserve.

1. It should be free from white settlers, or the need for meat and the predatory instinct will be too strong for any regulations. It is exceedingly difficult to apply a similar rule to natives, especially where they are nomadic, and, provided they are restricted to their traditional weapons it is probable that the toll they would take would not be serious. Where they have acquired modern rifles, as in Abyssinia, they are very dangerous neighbours to a game reserve. Sir Reginald Wingate told me that large numbers of Abyssinians come down from the hill country and destroy quantities of game between the Blue and White Nile, *i.e.*, in the heart of the reserve.

2. It should comprise a representative fauna, *i.e.*, as many as possible of the species inhabiting the adjoining countries.

3. A reserve should comprise abundant food and water, and such various aspects, elevations and conditions of forest, grassy plain and green glade as will serve for the support of the animals using it, as well as for shelter from sun and cold wind, while it should be of such dimensions as will cover their migrations at all seasons of the year. It is of the greatest importance to make the reserve of ample size from the beginning. It can at any time be reduced, but it is most difficult to extend it. The great obstacles which our American cousins are encountering in making the extensions of the National Park, which they now desire, is that they have permitted settlements on its borders. The reserves which we possess have apparently been selected in some cases by mere reference to the map, or at least with inadequate local knowledge, or due consideration of the habits of the game, especially of the larger species, whose instincts impel them to travel long distances. Another reason against restricting a reserve to too small an area is the danger of breeding in and in.

The Forest of Bielovege, in Lithuania, is the property of the Emperor of Russia, and for hundreds of years the hunting rights were the appanage of the kings of Poland. It is almost the sole remaining habitat of the Auer oxen or European bison. Although it is of immense size, probably 600 or 700 square miles, I have been told by a distinguished naturalist that in specimens submitted to him he had detected symptoms which satisfied him that interbreeding had done its work, and that the race is deteriorating.

4. The fourth essential is that the reserve should be easily supervised and watched. Thus, to my mind, the reserve on the Uganda

Railway is, in this respect, an ideal one, as the railway bounds one side of it for a distance of 200 miles, and it can hardly escape notice if a party enters it, at least from that side. On the other hand, an enormous tract nominally marked out as a reserve in the neighbourhood of Lake Rudolf, though it looks very well on the map, seems at present useless for the purpose, as very few Europeans go there, and if they did it is too far from any civilised base to be subject to any supervision. The fact is, though it may seem anomalous, the nearer a reserve is to civilised and populous places the better. Unless they are molested, wild creatures have no objection to the neighbourhood of man. At Wanstead-park, five miles from the Bank of England, my son found three otters a few weeks ago on one of the islands in the principal lake. They had, of course, come up the little River Roding, braving the dangers of dirty Barking Creek. The park is now almost surrounded by a dense population, and there were at the time scores of people on the paths round the lake. The herons, who are among the shyest of birds, at the same place have brought up over fifty families this year.

The question of the control of the African reserves is an urgent one, and the Government does not seem inclined to spend any money in watchers. An eminent official on the spot writes to me :—"As there is no body of game police the reserve cannot be watched. This matter of watching is, of course, entirely one of expense. If the money were available, watchers could be procured." Why is there no money available, and why are there no game police? I venture to think that this economy is misplaced. In my opinion the wealth of animal life in our African possessions is a thing of beauty and should be a joy for ever. Just as no care is too great to take of our art possessions in the National Gallery, upon the acquisition and custody of which we spend enormously, this varied and exquisite heritage of wild creatures should be regarded as a possession equally precious and irreplaceable, of which the whole Empire should be proud. We have spent six millions on the Uganda Railway. The commercial results are doubtful, but there is at least this unique attraction which must appeal to the sternest economist of the abounding wealth of life in the countries through which it passes. From the windows of the train I have myself seen ostriches which are shyer than any antelope, ungainly rhinoceroses, zebras cantering along parallel with the train, huge herds of wildebeest, the stately Grant's gazelle and the still more graceful impala, bounding out of sheer joyousness ten feet into the air, as well as the smaller kinds of antelope, while giraffes and lions are occasionally observed. This living gallery of moving pictures is surely worth a few hundreds a year to preserve.

We have been warned already. The American bison is all but extinct, the quagga and bluebok have disappeared for ever from the earth's surface. Of the African elephants only a small percentage remain. Why should that interesting survival, or the koodoo, or the eland, to mention some of those which seem to me in imminent danger, not to speak of many others, follow the same tragic road? Surely a small expenditure might be incurred to avoid that result. This remark applies, I think, to nearly all the reserves in Central or Eastern Africa. They are not guarded or watched.

The Soudanese reserve on the right bank of the White Nile, and between that river and the Blue Nile, is another tract which is well chosen and favourably placed owing to the constant patrolling of both rivers by Government boats. I trust that the reported intentions of the Government to do away with this reserve will be reconsidered. I recently had occasion to criticise publicly the terms of the Soudanese game regulations, which permit the officers stationed in the Soudan to hunt in it. Wherever it exists, this rule, or, rather, relaxation of a rule, seems to me to transgress the first principles of a reserve. That kind of exception has a tendency to grow. When I was in East Africa it had been understood that all protectorate officials might shoot in the reserve. This had been gradually extended to all the railway officials, so that at that time there was perhaps more shooting in the reserve than anywhere else in the territory, many coming considerable distances for a few days shooting in the so-called sanctuary. That has now been put a stop to in British East Africa by the firmness of a good sportsman, Sir Clement Hill, and leading administrators on the spot, and the game within the reserve appears to be well guarded against privileged destruction.

In his report just issued on Egypt and the Soudan, Lord Cromer replies to certain criticisms of mine, on the administration of the game laws in the southern province, contained in my book, "Two African Trips," lately published. The report raises such important

principles that I shall hope to be excused for dwelling on it for a few minutes. He thus defends the system:—

"In dealing with this subject it must be remembered that the visitor comes to the Soudan for the purposes of travel and recreation during the least trying season of the year. The officers, on the other hand, have, for the most part, to live a very hard and solitary life in a most trying climate during the greater portion of the year. In my opinion it is perfectly justifiable, in part return for the excellent and very arduous services rendered by the British officials, civil and military, in the Soudan, to allow them certain privileges in the matter of sport."

These are weighty words and, even if they did not come from so great an authority, I entirely concur with the principle laid down, provided it is applied within reasonable limits, nor am I averse to the reservation of certain areas for the recreation of resident officers. But that is quite a different matter from allowing anybody, even if he be an official, to hunt in the game reserve, established for a totally different purpose, namely, the preservation of the species. Even if we regard the hunting privileges of the officers as the one thing to be favoured, because of the attraction they afford to the service, surely it is of importance to see that the stock of game is maintained. What consolation will it be to the officers "on the spot" twenty years hence, that their predecessors had splendid shooting, if the game has been killed off before their time?

But these expressions of Lord Cromer's raise a very important and delicate question which has a bearing on our subject of to-night, and which cannot be dismissed with a word. It is the game rivalry, if I may so express it, between the officials on the spot and the civilian traveller or sportsman, in a word, the British citizen. Having got the best game laws that can be devised, are they to be administered in the interest of the game, or of the officials, or of sportsmen generally, including the officers? It must be remembered that these laws are enacted by officials and administered by them. It becomes therefore very important that there should be no suspicion that they are administered other than with perfect impartiality. I venture to urge that the interest of the game is paramount over either of the others, because you can always relax your rules, but you can never recover an extinct animal.

But as regards the case between official and traveller, let me, by way of illustration, remind you of the conditions and restrictions which obtain in the Soudan. Consider the extent of the game areas. Not only the game reserve which lies between the White and Blue Niles, but nearly the whole of the vast territories to the west, south, and east of those two rivers, which comprise all the best game districts, are practically closed as hunting grounds to the ordinary traveller, but permitted to resident and non-shooting traders.

Lord Cromer says:—"Mr. Buxton, if I understand rightly, also advocates that Darfour, Kordofan, and the region about the Sobat, districts which are at present closed, should be thrown open to sportsmen." Well, I do so as to parts of them, and with reasonable limitations. Lord Cromer and Sir Reginald Wingate must of course be the final judges as to the conditions in any district and at any time. The murder of Lieut. Scott-Barbour in the neighbourhood of Bahr el Ghazal two years ago, to which Lord Cromer refers, cannot permantly necessitate this stringent exclusion over an area as large as Germany and France. Such a measure has never before been adopted in Africa, at least to the extent of closing a province. There are wider reasons, apart from my subject to-night, why the best class of British travellers should not be so rigidly excluded, especially as Lord Cromer gives a favourable account of the contentment and progress of the tribes inhabiting those regions. He says, "Everywhere I went, from north to south and from east to west, I found that, compared to last year, villages and cultivation had increased, security prevails, and general satisfaction is expressed with the present rule," and again, "Those remarkable pioneers of commerce, who are to be found in such large numbers amongst the Greek community, have established themselves in almost every town in the country." If Greeks may go, why not Englishmen? It is therefore to be hoped that ere long these regions will, in the natural course, be as open as other parts of Africa.

It is, however, important to call attention to the practical effect of this measure on the game. For the last two years all unofficial travellers or hunting parties passing through Khartoum have been, owing to this measure of exclusion, concentrated on an extremely small strip on the western bank of the White Nile. The effect of this has been seriously to deplete the game on that limited area, and I am informed by some who have been there that there is now little left except a few animals walking about on three legs. Doubtless this is an exaggeration. Nevertheless, the fact

remains that it is not good policy to concentrate a number of hunting parties on a small area. Indeed, Mr. Butler, the Game Officer, writes:—"The West Bank of the White Nile has been heavily shot over this year. It will be an advantage when a greater selection of routes can be offered to shooting parties, which will result in the killing of game being more generally distributed and less localised." Mr. Butler also recommends that no districts shall be specially reserved for officers, but that a smaller tract of country should be treated as a complete sanctuary, where no one, whether officer or visitor, should be allowed to shoot. In this recommendation Lord Cromer concurs. I do not wish to be captious, but why reduce the present reserve at all. There are vast game areas outside of it, as, for instance, the classic hunting grounds on the Blue Nile tributaries, made famous by Sir Samuel Baker, which were closed until the delimitation of the frontier with Abyssinia was completed. My criticisms were addressed to the fact that the so-called reserve was not a true sanctuary. It will be a poor consolation to me if the result of my suggestions is not to exclude the officers from that area but to admit the outsider as well to a considerable part of it. But I learn from another official source the details of what is proposed to be done. It is best explained by reference to a map. It is proposed to divide the present reserve into two parts—the northern portion to be open to officials, the southern to unofficial travellers. It will therefore, to my great regret, cease to exist as a reserve. A new reserve is to be created on the Zeraf, much further to the south; but this district is mainly sudd—that is, shallow lake and quaking moss, unsuitable for most species, and much too remote for practical supervision. The present reserve is free from these objections and is the resort of all the species in the district.

The proper remedy is to preserve the sanctity of the reserve as it is, and perhaps to allot certain good shooting districts to the officers alone, and to throw open other wide districts, where the population is friendly, to all alike. Of course with due restrictions as to numbers to be killed.

To return to the other reserves, some of those in Central and East Africa are far too small for the reasons already given, for instance, in the Somali Protectorate the Aden Garrison Reserve after twenty years use was so completely shot out that it was abandoned as such, and two other small reserves established rather further from the coast. One of these, the Mirzo Reserve, was especially designed to provide a sanctuary for the greater koodoo, one of the most rapidly disappearing of the larger mammals of Africa. This reserve, as I understand, is only twenty miles long by ten broad. Anyone who knows the habits of these larger antelopes and the distances to which they wander for food at different seasons of the year will realise how little protection such an area would afford, especially where, as in this case, there is the additional fatal blot that the officers of the Aden Garrison are permitted to hunt in this tiny park on obtaining leave from the Consul-General.

Next in importance to the establishment of the game reserves, I consider the provision which is now to be found in all sets of regulations for the provinces of Central Africa, but not I fear in the South African colonies; namely, the obligation upon every person taking out a license, to furnish, on its expiration, a return of the game which he has killed, specifying the number and sex of each species. This condition should be imposed upon all sportsmen without distinction, and is valuable for two reasons—one is the moral effect on the careless sportsman, who is certain to acquire some sense of responsibility when he bears in mind the necessity of setting down in black and white for official inspection the result of every successful shot. The other reason is that these returns may, and I hope will, be collected from the various colonies and protectorates under the Foreign Office and Colonial Office, and issued as a Parliamentary Paper. In the hands of an intelligent naturalist, it will serve as a most valuable comparison from year to year of the relative abundance or scarcity of the species. I regret to say that to my knowledge these returns are not always demanded from sportsmen. When their value is recognised I am confident that a stricter enforcement of the rules will be general.

Some of the officers concerned have hardly realised the importance of insisting on these returns; even one or two omissions vitiate the combined total, and naturally lead to laxity in other cases. The real sportsman should welcome this rule, while the inexperienced one ought to be taught self restraint.

I venture also to urge on the authorities that these returns should show how many licenses have been taken out in each class, and if any proceedings have been taken against offenders, and, if so, with what result. While on this point, I wish to urge that the responsibility of instituting such proceedings should not rest

with the game officer when he is quite a junior official, but should be undertaken by the chief officer in the protectorate or province. I have been shown this morning the following return for 1902 of game killed in East Africa. This is admirably arranged and is a model of the way these returns should be prepared.

The division of game into various categories; the "royal list" comprising the animals of such rarity that they may not be shot at all; the larger animals and slow breeders, such as the greater koodoo, rhinoceros, elephant, and roan antelopes, of which only two may be killed, and the commoner antelopes, of which a larger number is allowed, has already proved invaluable in many cases. The Government in each colony or protectorate should take into consideration from time to time the expediency of adding to this list species which have become rare, or removing others which no longer require this exceptional provision. The value of this provision is illustrated in the case

RETURNS OF GAME SHOT IN EAST AFRICA IN 1902, UNDER 68 PUBLIC OFFICERS' LICENCES, 18 SPORTMEN'S LICENCES, AND 12 SETTLERS' LICENCES. (APRIL 11, 1903.)

Game Killed on Sixty-Eight Public Officers' Licences issued 1902.

Species.	Male.	Female.	Districts.
Elephant	2	1	2, Naivasha ; 1, Baringo.
Rhinoceros	13	1	11, Baringo ; 1, Makindu ; 2, Kenia.
Hippopotamus	20	7	24, Baringo ; 3, Lake Victoria.
Eland	2	1	Baringo.
Buffalo	..	..	
Hartebeest, Neuman's	8	1	6, Nakuro ; 3, Baringo.
,, Coke's	108	13	101, Athi ; 20, Naivasha and Kenia.
,, Jackson's	19	3	10, Mau ; 12, Baringo.
Topi	10	..	2, Jubaland ; 4, Baringo ; 4, Mau.
Wildebeest	29	12	40, Athi ; 1, Kenia.
Duiker	16	1	7, Baringo ; 7, Athi ; 1, Makindu ; 1, Coast.
Dikdik	24	12	21, Baringo ; 11, Kenia ; 4, Coast.
Oribi	44	5	19, Baringo ; 9, Kenia ; 21, Mau.
Stienbuck	50	15	29, Athi ; 36, Baringo.
Klipspringer	10	2	Baringo.
Waterbuck	59	5	2, Jubaland ; 9, Athi ; 13, Kenia ; 35, Baringo (Defassa) ; 2 Mau (C. Defassa) ; 2, Coast.
Reedbuck	44	5	30, Baringo ; 1, Makindu ; 16, Mau ; 2, Coast.
,, Chanler's	20	2	21, Baringo (Eburru) ; 1, Athi.
Impalla	75	5	12, Athi ; 57, Baringo ; 2, Kenia ; 2, Makindu ; 7, Mau.
Thomson's gazelle	101	18	57, Athi ; 52, Baringo.
Grant's gazelle	113	23	77, Athi ; 58, Baringo ; 1, Makindu.
Peter's gazelle	3	..	2, Coast ; 1, Makindu.
Waller's gazelle	2	..	Jubaland.
Oryx beisa	4	1	Baringo.
Callotis	4	4	Makindu.
Bushbuck	17	3	17, Baringo ; 2, Athi ; 1, Coast.
Bongo..	1	1	Ravine.
Roan	1	..	Baringo.
Zebra	26	3	17, Baringo ; 15, Athi ; 3, Mau.
Wart hog	21	5	11, Athi ; 13, Baringo ; 2, Kenia.
Pig	2	2	1, Baringo ; 3, Athi.
Colobus monkey	2	..	Mau.
Ostrich	2	..	Athi ; Kenia.
Jackal	2	..	Baringo.
Greater Kudu	4	..	Baringo.
Thomas's cob	1	..	Lake Victoria.
Serval	4	1	3, Baringo ; 1, Athi ; 1, Makindu.
Marabout	8	..	Athi.
Total ..	871	152	= 1,023.

Game Killed on 18 *Sportmen's Licences issued* 1902.

Species.	Male.	Female.	Districts.
Elephant	1	..	Coast (Takaungu).
Rhinoceros	13	5	8, Baringo; 8, Athi; 1, Tana; 1, Seroni.
Hippopotamus	3	9	1, Athi River; 2, Naivashâ; 1, Coast; 7, Baringo.
Buffalo	1	..	Tana.
Eland	2	1	2, Baringo; 1, Athi.
Hartebeest, Neuman's	10	2	Nakuru.
,, Coke's	48	14	53, Athi; 1, Kenia; 3, Naivasha; 5, Makindu.
,, Jackson's	9	1	Baringo.
Topi	14	2	9, Mau; 7, Tana.
Wildebeest	19	2	20, Athi; 1, Makindu.
Duiker..	2	..	Athi-Makindu.
Dikdik..	15	10	14, Baringo; 8, Kenia; 3, Seroni.
Oribi	2	..	Mau.
Stienbuck	10	6	5, Athi; 11, Baringo.
Klipspringer	3	..	Baringo.
Waterbuck	24	2	11, Athi; 14, Baringo; 1, Tana.
Reedbuck	6	1	Baringo.
,, Chanler's	3	..	Baringo (Eburru).
Impalla	47	5	11, Athi; 24, Baringo.
Grant's gazelle	69	5	28, Athi; 43, Baringo; 3, Seroni.
Thomson's gazelle	57	2	32, Athi; 22, Baringo; 5, Seroni.
Oryx beisa	6	..	4, Baringo; 2, Tana.
Bushbuck	10	3	2, Athi; 11, Baringo.
Kudu lesser	1	..	Tana.
Wart hog	9	3	5, Athi; 4, Baringo.
Zebra	15	4	13, Athi; 6, Baringo.
Lion	5	2	6, Athi; 1, Tana.
Cheeta	2	1	2, Baringo; 1, Athi.
Serval	7	1	1, Athi; 7, Baringo.
Various antelope	10	..	Near Lake Victoria.
Total ..	423	81	= 504.

Game Killed on Twelve Settlers' Licences in 1902.

Species.	Number.	Districts.
Hippopotamus	3	Lake Victoria; Athi.
Hartebeest	64	2 Mau; 9 Baringo; 53 Athi.
Wildebeest	16	Athi.
Oribi	20	2 Baringo; 18 Mau.
Stienbuck	2	1 ,, 1 Athi.
Waterbuck	7	2 ,, 1 Mau; 1 Athi.
Reedbuck	5	1 ,, 2 ,, 3 ,,
Thomson's gazelle	55	8 ,, 4 ,, 43 ,,
Grant's gazelle	50	5 ,, 3 ,, 42 ,,
Impalla	6	1 ,, 5 Athi.
Bushbuck	1	Athi.
Wart hog..	6	1 Baringo; 1 Mau; 4 Athi.
Various	4	Athi.
Total ..	239	

Totals.
1,023
504
239

Gross Total 1,766

(Signed) A. BLAYNEY PERCEVAL,
Game Ranger.

of the elands and buffalo in British East Africa. This noble game had become very rare there four years ago. Now, owing to the special protection which they have received, they have to some extent recovered their numbers or immigrated, and considerable herds have been seen this year by sportsmen. The last measure of protection which I desire to emphasise is the prohibition of the export of skins. It must never be forgotten that it was the hide hunters who were mainly responsible for the destruction of the buffalo on the prairies of America. Let me give an instance. The skins of the beautiful colobus monkeys, exported from the Gold Coast, numbered 188,000 in 1892. Every year the supply diminished, until in 1898 the return was only 1,067, and by now they probably are exterminated.

Finally, may I make the following suggestions:—In our own territories, reserves which are too small should be at once extended to cover the migrations.

The returns of game killed by licencees in all provinces should be published as a Government return, showing a comparison from year to year since the date upon which they became obligatory.

In conclusion, I ask all those interested, to bear in mind there are certain classes of animals in special danger, and who should be, therefore, specially guarded. They are:—

(1.) Those having a very limited habitat, such as the greater koodoo or the white-eared cob on the White Nile.

(2.) Those animals which pasture on open plains, and which, owing to their conspicuous position, and to the power and range of the modern rifle, are subject to a new danger.

(3.) The larger mammals, because they also are conspicuous and easily pursued, and especially on account of their slow breeding.

The parties to the International Conference bound themselves by the Convention of May 19th, 1900, to the establishment of reserves, and to communicate to one another the positions of such reserves. They also agreed to confiscate all elephant tusks below the weight of 11 lbs. I hope means may be found—if I may use such an expression in connection with such an august subject—to jog the other Powers.

DISCUSSION.

The CHAIRMAN said the valuable paper which had been read opened up many questions, which he hoped would be fully discussed, as there were present in the audience administrators from the regions referred to, those who had directed Protectorates, and sportsmen who had hunted in every part of the Continent. He thought it was fortunate that the British had taken over the East African Protectorate when it did. When he went with Livingstone he could count from the steam launch 400 elephants at one time, and they had often to be fired at to get them out of the way so as to enable the boat to pass through. Soon afterwards sportsmen went up, and in the course of a few years the elephants practically disappeared. But under the regulations which had now come into force the game was beginning to return. Englishmen were fortunate in having the finest preserve of all in East Africa; it was all open ground traversed by the railway, and every one could see for himself. He had only returned from it two months ago, and in February he was up the Uganda Railway, but he was not fortunate in seeing so many animals then as Mr. Chamberlain did just before—when they had all been driven up to look at him. But we were only just in time to save the animals, because when we took the country the reduction in them was not so much due to man as to the rinderpest. In a few more years the rinderpest and the huntsman's rifle would have cleared out all the game in the country. One enemy of game there had not been referred to, viz., the lion. Two months ago, he and his fellow travellers received a telegram saying they were not to expect the signal-man to be on duty at the next station as there were four lions on the railway, two of them in front of the station-master's house, the station master having sent the message from his house. But when the train arrived, the lions had gone.

Sir WM. LEE-WARNER, K.C.S.I., said Mr. Buxton was the right man to give such a paper, he had come to the right place to advocate his cause, and he had advocated it in the right way. He (Sir W. Lee-Warner) paid a warm tribute to the author's experience, love of nature, and knowledge of sport. Undoubtedly, progress in the matter must be made by working on public opinion, which must influence sportsmen, and no one could preach with more authority as a sportsman than the author. Later one could work on the Government. But the rate of progress depended on administration. The export of skins and horns of protected animals could first be stopped. Then when the State owned forests, it could regulate shooting in them. The third stage of protection was reached when municipal, cantonment, and other local bodies closed their markets to the products of unlawful chase. But at each stage the people must be allowed to protect themselves from attack by wild beasts.

Sir HARRY JOHNSTON, G.C.M.G., K.C.B., said the chief value of the wild creatures in Africa was an æsthetic one; they formed an important part of the beauty of the landscape, and were also beautiful in themselves. He had lately had occasion to observe how few mammals remained in the British Isles. Of those the otter was among the most beautiful and interesting; yet he had seen a newspaper para-

graph which congratulated some snobs who had established themselves on a little river in Sussex, in which a few otters still lingered, that they had started a pack of otters hounds to kill them, solely because the sport was deemed fashionable. In the subject under discussion, he would go even further than the author had gone, for Mr. Buxton was the most reasonable and tender sportsman, who, if he had killed anything, had done it with the idea of enriching collections and enlarging our knowledge of the animals and their structure. It was necessary to work on the minds of our fellow countrymen. The only official he had known who took an active interest in the matter, to the point of getting himself disliked in enforcing the game regulations, was Sir Clement Hill. In Uganda he (Sir Harry) had the greatest difficulty in enforcing the game regulations until Sir Charles Elliott came. Until people who were very good in other respects were brought to see as Mr. Buxton and he did about the question, ordinances would not affect very much. Mr. Buxton had started a new school, one to go out armed with the camera instead of the rifle, and he (Sir Harry) was a convert to it already. It should be regarded as a low-class thing to kill interesting and beautiful creatures, some of which were far more beautiful than the very common species which killed them.

Sir CLEMENT HILL, K.C.M.G., said that the Government regulations which were administered throughout most of the East African Protectorates were the result of the deliberations of a committee consisting of such men as Mr. Selous, Mr. Jackson, Mr. Buxton, and Sir John Kirk. Those regulations, he thought, had been administered with some success, as shown by statistics. Not only was an effort being made to protect the animals, but also to increase their numbers, and to turn them to useful account. He instanced the case of the zebra, for 85 of them were in an enclosed area, and horses were to be sent out from this country to interbreed, with the idea of obtaining useful hybrids. Professor Ewart and the council of the Zoological Society were interested in the matter. He believed the Government were alive to the importance of protecting the animals, but what was the use of laws without public opinion? If people going out to Africa would insist on the carrying out of the laws instead of boasting that they had been easily able to hoodwink the officials, and would regard it as a crime to kill the females and immature males as much as to kill foxes in England at the present time, great advances would be made.

Mr. F. C. SELOUS thanked Mr. Buxton for his work in bringing to the consciences of Englishmen the need for measures to strengthen the preservation of the big game still existing in Africa. But there were great difficulties. In such countries as the United States was it a disadvantage that animals such as the bison were less numerous, or was it not better to have waving cornfields and homesteads than tracts of wild lands inhabited by the buffalo? If a country was capable of supporting a white population it was impossible preserve game in pristine abundance. Much had been said about the depredations of the British sportsman in the matter of killing off the animals, but no mention has been made of the native. One of the reasons why vast tracts in Africa had been kept without inhabitants, and been peopled by wild animals, was the devastating raids carried on all over the continent by war-like tribes, so that the country was denuded of its human inhabitants, and opportunity given for the increase of wild animals. He gave several instances of this in South and Central Africa. He was able to exclude the tsetse fly in the cases he referred to, because the people had large numbers of cattle where they settled. But when there was the *pax Britannica* those raids were prevented, and then there was a probability of the population increasing. He thought careful guard would have to be kept to prevent the native African races from exterminating the game. It was easy to regulate the white sportsman, but not so the black, especially if armed with modern rifles. Mr. Buxton had said that 30,000 elephants were killed annually in Africa, but he questioned whether 20 of them were slain by the white man. So long as the native could get money for ivory he would kill the elephant somehow.

Mr. ALFRED SHARPE thought every one who had lived for any time in less civilised regions would agree with the remarks of Mr. Buxton; but the point which had occurred to him was that mentioned by Mr. Selous, viz., that it was the black man who did most of the mischief. Ten years ago, in Central Africa, every native had a gun, which he used on game, killing anything he could get; but at the present time, a native with a gun could scarcely be seen. That was largely due to the gun tax—about 3s. a year, representing a month's native wages — which Sir Harry Johnston enforced about the year 1892. There was no reason, in his opinion, why the game of Africa should not be preserved for all time. With regard to reserves, it was easy to mark an area out on a map, call it a reserve, and suppose it was so, but it was quite another matter to make it a true preserve, especially while the natives possessed guns. He thought no shooting whatever should be allowed in reserves, and then game might be preserved for all time.

Commander B. WHITEHOUSE, R.N., spoke of the huge quantities of big game he recently saw along the Uganda Railway, more than he had ever previously observed; even ostriches and zebras were seen quite close to the railway. He thought the author was in error in stating that the railway officials were allowed to shoot in the reserve. He was in the reserve for a long time, but was not allowed to shoot there.

Sir HENRY SETON-KARR, M.P., pointed out how successful the regulations for preserving game had

been in the National Park at Wyoming, U.S.A. No one was allowed to fire a shot in it. The great fault of reserves in Africa was that their sanctity was not observed, and too little money was spent in policing them. Moreover, the effect of killing even a few of the animals in the reserve—the sound of shots—was bad; it showed the animals that they were not safe from slaughter. Americans had learned a lesson by experience. If the buffalo had not been exterminated there, plenty of room still remained for it. The buffalo could live through the winter, but the ordinary cow could not; but, perhaps, if the buffalo had been preserved and crossed with the cow, a hardier species of cattle would have resulted which could stand the winter. He trusted more money would be spent by the Government to prevent shooting in the reserves.

Mr. BUXTON, in a brief reply, said, in reference to Commander Whitehouse's remark, that officers sometimes interpreted rules in their own favour.

A hearty vote of thanks was carried to Mr. Buxton, on the motion of the CHAIRMAN, and the meeting terminated.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evening, at Eight o'clock:—

MAY 20.—"Fencing as an Art and an Historic Sport." By EGERTON CASTLE, M.A.

APPLIED ART SECTION.

Tuesday Afternoon, at 4.30 o'clock:—

MAY 19.—"Mezzotints." By CYRIL DAVENPORT, F.S.A. SIDNEY COLVIN, M.A., Keeper of Paints and Drawings, British Museum, will preside.

CANTOR LECTURES.

Monday Evening, at Eight o'clock:—

MAY 18.—"Mechanical Road Vehicles." By W. WORBY BEAUMONT, Mem.Inst.C.E. (Lecture IV.)

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 18...SOCIETY OF ARTS, John-street. Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. W. Worby Beaumont, "Mechanical Road Vehicles." (Lecture IV.)

Optical, 22, Hanover-square, W., 8 p.m, Mr. A. J. Bull, "Modern Developments in Colour Photography."

Surveyors, 12, Great George-street. S.W., 8 p.m. Discussion on the Paper by Mr. H. Trustram Eve, "Modern Methods of Valuation of Manurial Residues."

Geographical, University of London, Burlington-gardens, W., 3 p.m. Annual Meeting.

British Architects, 9, Conduit-street, W., 8 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. W. H. Frazer, "Experiences in South Africa during the War."

TUESDAY, MAY 19...SOCIETY OF ARTS, John-street, Adelphi, 4½ p.m. (Applied Art Section.) Mr. Cyril Davenport, "Mezzotints."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. G. H. Darwin, "The Astronomical Influence of the Tides." (Lecture II.)

Designers, Clifford's-inn, Fleet-street, E.C., 8 p.m. Mr. J. J. Brownsword, "The Form and Features of the Human Head."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. D. A. Thomas, "The Growth and Direction of our Foreign Trade in Coal during the last Half Century."

Pathological, 20, Hanover-square, W., 8½ p.m. Annual Meeting.

Anthropological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, MAY 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Egerton Castle, "Fencing as an Art and an Historic Sport."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Meteorological, 70, Victoria-street, S.W., 4½ p.m, 1. Mr. Charles P. Hooker, "The Relation of the Rainfall to the Depth of Water in a Well." 2. Mr. William Marriott, "The Frost of April, 1903."

Chemical, Burlington-house, W., 5½ p.m. 1. Messrs. G. Tattersall and F. S. Kipping, "Isomeric Partially Racemic Salts containing Quinquavalent Nitrogen. Part XI. Derivatives of Dl-methylhydrindamine and Dl-neomethylhydrindamine. Isomeric Salts of the type N R1 R2 H3." 2. Mr. V. H. Veley, "The Conditions of Decomposition of Ammonium Nitrite." 3. Messrs. W. R. Lang and E. H. Jolliffe, "Note on the Action of Methylamine on Chromic Chloride." 4. Messrs W. R. Lang and C. M. Carson, "The Action of Liquefied Ammonia on Chromium Chloride."

Microscopical, 20, Hanover-square, W., 8 p.m., Exhibition of Pond Life.

THURSDAY, MAY 21...Society for the Encouragement of Fine Arts, 6½, Suffolk-street, Pall-mall, S W., 8 p.m. Mr. A. Diosy, "Our Allies in the Far East."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. Sidney Vines, "Proteid Digestion in Plants." (Lecture II.)

Historical, Clifford's Inn Hall, Fleet-st., E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Mining and Metallurgy, at the Rooms of the Geological Society, Burlington-house, W., 8 p.m., 1. Mr. J. N. Justice, "Diamond Drilling in West Africa." 2. Mr. H. Kilburn Scott, adjourned discussion "On the occurrence of Mica in Brazil, and on its preparation for the market." 3. Mr. J. E. Clennell, "Analytical Work in Connection with the Cyanide Process." 4. Mr. Leslie Symonds, "Notes on the Treatment of Gold Slimes in Venezuela." 5. Mr. H. A. Barker, "Notes on Cupriferous Cyanide Solutions." 6. Mr. M. Roberts, "Notes on Chorolque Tin Mines and Alluvial Deposits, Bolivia."

FRIDAY, MAY 22...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Dr. J. A. H. Murray, "Dictionaries."

North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne.

Clinical, 20, Hanover-square, W., 8½ p.m. Annual Meeting.

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

SATURDAY, MAY 23..Royal Institution, Albemarle-street, W., 3 p.m. Mr. F. Corder, "The Evolution of Music." (Lecture II.)

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FRIDAY, MAY 22, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

The Society's Conversazione will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, June 30th, from 9 to 12 p.m.

The programme of arrangements will be announced later.

Each member is entitled to a card for himself (which will not be transferable), and a card for a lady. These cards will be forwarded in due course. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the date of the Conversazione. On that day the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Tickets will also be supplied to non-members on presentation of a letter of introduction from a member.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

CANTOR LECTURES.

Mr. W. Worby Beaumont, M.Inst.C.E., delivered the fourth and last lecture of his course on "Mechanical Road Vehicles," on Monday evening, 18th inst.

A vote of thanks to the lecturer was passed on the motion of the Chairman.

The lectures will be printed in the *Journal* during the autumn recess.

APPLIED ART SECTION.

Tuesday afternoon, May 19, Sidney Colvin, M.A., in the chair. The paper read was on "Mezzotints," by Cyril Davenport, F.S.A.

The paper and report of the discussion will be published in a future number of the *Journal.*

Proceedings of the Society.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 20, 1903; Percy R. Macquoid, R.I., in the chair.

The following candidates were proposed for election as members of the Society:—

Dawson, Robert A., A.R.C.A., Municipal School of Art, North-street, Belfast.

Farrell, John R., 30-31, Clement's-lane, Lombard-street, E.C.

Fremantle, Selwyn Howe, 44, Lower Sloane-street, S.W.

Halsey, Frederick A., "The American Machinist," World-building, New York City, U.S.A.

Hodgkinson, William, Messrs. Balmer, Lawrie, and Co., 103, Clive-street, Calcutta, India.

Janni, Chevalier Joseph, Riverbank, Sunbury-on-Thames.

Kirkham, Rev. Philip H., M.A., St. Luke's, S.P.G., Toungoo, Burma.

Luboldt, F. W. August, "Breakspears," Hornchurch, Essex.

Temple, Bernard, "The Pioneer," Allahabad, India.

Vischer, Hans, M.A., Royal Societies Club, St. James's-street, S.W., and 14, Sonnenberg, Bern, Switzerland.

The following candidates were balloted for and duly elected members of the Society:—

Casson, Thomas, The Positive Organ Co., Limited, 17, Harewood-place, Hanover-square, W.

Cliff, Richard C., A.M.I.E.E., Cape Government Railways, P.O. Box 291, Cape Town, South Africa.

Ellison-Macartney, Right Hon. William Grey, The Royal Mint, E.C.

Gordon, Rev. Charles W., Winnipeg, Manitoba, Canada.

Lewis, Mrs. S. S., Castle-brae, Chesterton-road, Cambridge.

Wainwright, Harry S., South Eastern and Chatham Railway, Ashford, Kent.

The CHAIRMAN said he was present that evening for the very pleasant purpose of introducing to the audience Mr. Egerton Castle, who amongst his many other accomplishments was a past master in the art of modern swordsmanship as well as in all the various methods of fence that were formerly employed.

The paper read was—

SWORDSMANSHIP CONSIDERED HISTORICALLY AND AS A SPORT.*

By EGERTON CASTLE, M.A., F.S.A.

From the general title of this paper it will be seen that the subject is a very wide one—one which could be treated in a variety of ways. Indeed, it will be necessary—given the space and time at my disposal—to restrict its consideration to certain lines and no others.

Some twelve years ago, at the request of Mr. Henry Irving, I delivered, on the stage of the Lyceum, a lecture, practically illustrated, sword in hand, by myself, with the kind help of some noted experts, among others Sir Frederick Pollock, Mr. Walter Pollock, and Captain Hutton.

On the stage of the Lyceum I had unlimited elbow room—and, indeed, to illustrate the proper wielding of such weapons as the two-hander of King Hal's days, and the Elizabethan tucke, a good deal of room is necessary, but even then I had to restrict considerably the scope of my disquisition. To-night this restriction is still more imperative, and I will therefore content myself with reference to the historical aspect of swordsmanship, with a very brief conspectus of the evolution of regulated sword-play from the 16th century.

It may be stated from the outset that, although swordsmanship as a sport cannot yet be considered a popular one in England, although its adepts are few and none of them may be said to be of European reputation, nevertheless, it is in England beyond doubt that the true history of the art has been reconstructed. The pioneer in this branch of investigation was Sir Frederick Pollock, who not only wrote but lectured on this chosen subject some twenty years ago. Much had been written on the history of swords-play in France, Italy, and Germany, but I take upon myself to assert that it was mostly uncritical stuff, based on much fanciful evidence. Next to Sir Frederick's essays on the subject, I may mention my book, "Schools and Masters of Fence," published in 1884, which seems to have been the starting point for a series of similar works both in England and on the Continent. And among the most copious and the most learned writers of modern days on the subject of swordsmanship, considered both historically and as a sport, is my friend, Captain Hutton.

If by fencing—the art of "fence," *i.e.*, defence or offence—we mean, generally, the dexterous use of the sword, the subject, as I have said, is wide indeed; as wide in fact as the history of the sword itself. This is too vast a ground to be covered by anything less than a book. The scope of our investigation is, therefore, confined to one kind of swordsmanship only: to that which depends on the regulated, artificial conditions of "single combat." It is indeed this play, hemmed in by many restrictions, which we have come to mean more specially by "fencing." It differs, of course, in many respects from what may be called the art of fighting in the light of nature. But as its restrictions are among the very elements which work to the perfection of the play as an art, it is undoubtedly in the history of swordsmanship as applied to *duelling* that we shall trace the higher development of the art.

It may be said that the investigation of the rules of sword-fight would be almost tantamount to a history of the origin of private duelling; but this is an ethical subject, and, again, one which would carry us too far. We will, therefore, take it up no further back than the middle of the 16th century, when, on the disuse of the mediæval wager of battle, the practice of *private duelling* began to take an assured footing in a warlike society.

It is curious to mark that the first cultivation of refined cunning in fence dates from that period, which corresponds chronologically with the general disuse of armour, both in battle and in more private fights. It is still more curious to note that, in order to fit himself to meet what was an illegal but aristocratic obligation, the gallant of that period had to appeal to a class of men hitherto little considered, to those plebeian adepts, in fact, who for generations had cultivated skill in the use of hand weapons, on foot and without armour, for their own protection. When you come to think of it, that sturdy and ponderous swordsmanship, devised and practised by the armour-clad man-at-arms, was really not of much use on a little morning expedition in plain trunk

* The right of reproducing this paper is reserved.

hose and doublet to the Pré-aux-Clercs or to West Smithfield. Nimble tricks had to be learnt; and the hitherto little-thought-of footman was the best, in fact the only available instructor.

And thus it came to pass that the earliest masters of fence in all countries, namely, the masters of the art of conducting skilfully what was essentially considered as an honourable encounter, were almost invariably to be found among a somewhat dishonoured gentry—gladiators, free companions, professional champions, more or less openly recognised, or bravoes of the most uncompromising character.

In Germany, which may be considered the cradle of systematic swordsmanship, these teachers of the sword formed themselves as early as the late 15th century into guilds, among which the best known were the Marxbrüder, or the Associates of St. Marcus of Löwenberg, which had head-quarters at Frankfurt and branches in all the more important German towns. Similarly, in Spain and in Northern Italy, professional swordsmen were at various times allowed to form themselves into recognised, or at least tolerated, associations.

In England, the class had always been looked upon with especial disfavour by the powers that were, until bluff King Hall (who was a devoted *ferrailleur*) had likewise the bright idea of turning their obnoxious existence to a disciplined and profitable channel by regularising their position. The most redoubtable masters were allowed to form themselves into a company, with powers to increase their numbers with suitable and duly tried men, in imitation of the world-famed German Marcusbrüder. Under these conditions they were granted the lucrative monopoly of teaching the art of fight in England. The enormous privileges that the King, in course of time, conferred on his Corporation of Masters of Defence, very soon enabled it to put down or absorb all the more ferocious of independent swashbucklers, and thereby to impart to the profession a moderate degree of respectability under the coat of arms granted by the royal heralds: gules a sword pendant argent.

It was in the bosom of such corporations, abroad and in England, and in fighting dens of independent swordsmen, therefore, that sprouted the first buds of systematic swordsmanship. Among these professionals, curiously and happily for the historian, there seem to have been a few with a literary turn of mind.

The oldest manuscript of fence belongs to Germany. It deals with the method of carrying out a wager of battle and the tricks of fight recommendable therefor. And pretty gruesome they are as a rule! I refer to *Thalhofer's Fecht-Buch*. The oldest printed book is likewise German: "*Ergündung der ritterlicher Kunst der Fechterei, von Andreas Paurnfeindt, Freifechter zu Wien*, 1516." This work, which is exceedingly rare, is a very complete exponent of the ways of using long and short swords to the utmost of their lethal capacity—and quite irrespective of any sense of mere decorum. It must have met what would now, in journalistic style, be called "a long felt want," for it was reproduced (under various attractive titles, very confusing to the bibliographer) in Frankfurt, Augsburg, Strasburg, and finally done into French under the name of "La noble Science des Joueurs d'epée," published in Paris and Antwerp, 1535.

Following the Germans, the oldest printed books of fence are Italian. Thus the first French book on the sword is shown to be a translation from the German. Curiously enough, the second, and perhaps the most notable, "*Le Traité de l'epée seule, mère de toutes armes*," of the Sieur St. Didier, published in Paris, in 1573, can be shown to be an adaptation of two Italian treatises, the "*Trattato di Scienza d'arme*" of Camillo Agrippa, and Grassi's "*Ragione di adoperar sicuramente l'arme, etc.*"

It is about this time, namely, the latter half of the 16th century, that we must take up our consideration of the development of swordplay pure and simple, for then a great change is perceptible in the nature and tendency of fence books: they approximate more and more to the consideration of what we *now* understand by fencing. The older works expounded the art of fight generally, taught the reader a number of valuable, if not always gentlemanly, dodges for overcoming an adversary *at all manner of weapons*: now the lucubrations of fence-masters during the last quarter of the 16th century deal almost exclusively with the walking sword, that is the duelling weapon: the rapier in fact, both with or without its lieutenant, the dagger.

It must be remembered that at this period private duelling and cavalier quarrelsomeness amounted to a perfect mania. The fencing master was no longer merely a teacher of efficacious, if rascally tricks; he was becoming a model of gallant deportment in the getting

in and out of honourable difficulties. In many cases he was even the recognised arbiter on matters of honour. He was often a gentleman himself; at all events he now posed as such.

Although the Germans were always redoubtable adepts at the rougher games of swordsmanship, it is in Italy that we find the first development of that nimbler, more regulated, more cunning, better controlled kind of play which we have learned to associate with the term "fencing." It is from Italy that fencing, as a refined art, first spread over Europe: not from Spain, as it has been asserted by many writers. It is in the Italian rapier play of the late 16th century that we find the foundation of fencing in the modern sense of the word. The Italians—if we take their early books as evidence, and the fact that their phraseology of fence was adopted by all Europe—were the first to perceive (as soon as the problem of armour breaking ceased to be the most important one in a fight) the superior capabilities for elegant slaughter possessed by the point as compared with the edge. They accordingly reduced the breadth of their sword, modified the hilt portion thereof to admit of readier thrust action, and relegated the cut to quite a secondary position in their system. With this lighter weapon they devised in course of time that brilliant, cunning, cat-like play known as rapier fence.

The rapier was ultimately adopted everywhere by men of courtly habit; but, in England at least, it was not accepted without murmur and vituperation from the older fighting class of sword men, especially from the members and admirers of the English Corporation of Defence Masters.

As a body Englishmen were as Conservative then as they are now. They knew the value of what they had as their own, and distrusted innovations, especially from foreign quarters. The old sword and the buckler were reckoned as your true English weapons: they always went together—in fact sword and buckler play in the 16th century was evidently held to be as national a game as boxing in our time—was it not a far more manly, honest and generous manner of settling differences then all your foreign tricky fence, such as rapier and dagger?

Many are the allusions in contemporary dramatic literature to this characteristic national distrust of Continental innovations. There is a passage in Porter's play, "The Two Angry Women of Abingdon" for instance:—"Sword and buckler fight," says a sturdy Briton, in much the same tone of disgust as a lover of fisticuffs might now assume when talking of Mounseer's foil play, "sword and buckler fight begins to grow out of use. I am sorry for it. I shall never see good manhood again. If it be once gone, this poking fight with rapier and dagger will come up. Then the tall man (that is a courageous man and a good sword-and-buckler man) will be spitted like a cat or a rabbit!"

The long sword, that is the two-hander, was also an essentially national weapon. It was a right down, pleasing and sturdy implement, recalling in good steel the vernacular quarter-staff. It required thews and sinews, and, incidently, much beef and ale. The long-sword man looked perhaps with even greater disfavour than the smaller swashbuckler upon the new-fangled "bird-spit." "Tut, man," says Justice Shallow, typical laudator of the good bygone days, on hearing of the ridiculous Frenchman's skill with his rapier, "I could have told you more. In these times you stand on distance, your passes, stoccadoes, and I know not what; 'tis the heart, Master Page; 'tis here, 'tis here. I have seen the time, with my long-sword, I would have made you four tall fellows skip like rats." Did the space at my disposal allow me to do so I could adduce scores of quotations revealing the popular disgust at the innovations introduced by the "fencers" in the art of fight.

Now, the play of sword-and-buckler and of long-sword was no doubt a manly pursuit, and a useful. But, as an every-day companion, the long-sword was incongruous to a fastidious cavalier; and, again, the buckler, indispensable adjunct to the good swashing blade of home production, was hardly more suitable. No doubt, on some discreet nightly expedition, your gallant might still carry his hand-buckler on his hip over his sword hilt; but, in Elizabethan days, it is obvious that the buckler was inadmissible as an item of gentlemanly attire. It was accordingly left to the body attendant, and the gallant took kindly to cocking his fine Milanese rapier behind him.

It is not difficult to understand the immense popularity, among the smart set of the time, of this nimble rapier, so much reviled by the older fighting gentry. The rapier, in fact, came in with the taste for cavaliero style, and may be looked upon as its fit outward symbol already in the days of Queen Mary. In Elizabeth's reign it was firmly established as your only gentlemanlike weapon.

The rapier was decidedly a foreigner; yet it

suited the Elizabethan age, for it was decorative as well as practical. Its play was decidedly picturesque, fantastic, almost euphuistic, one might say, in comparison with the matter of fact hanger of older days. Its phraseology had a quaint, rich, Southern smack, which connoted outlandish experience and gave those conversant with its intricate distinctions that marvellous character, at once precious and ruffling, which was so highly appreciated by the cavalier youth of the time. The rapier in its heyday was certainly an admirable weapon to look at, a delicious one to wield. And, besides, in proper hands, it was undoubtedly one that was most conclusive. It was, in short, as elegant and deadly as its predecessors were sturdy and brutal.

Space fails me here for going into technicalities. Let it suffice to say that by the time that the most perfect, namely the Italian, rapier fence came to be taught in England—that is during the last third of Elizabeth's reign—the theory of swordsmanship, as applied to single combat, after having passed through many phases of imperfection, was already tolerably simple and practical. (The curious may find the exact story of its evolution in my book, "Schools and Masters of Fence.") What may be considered as one of the cardinal actions of regulated sword-play on foot, namely, the lunge, had already been discovered. Although a great many movements, which, according to our modern notions, would be considered not only unnecessary but actually pernicious, still formed part of the system, I doubt whether, on the whole, anything very much better could be devised, even in our present state of knowledge, if we consider the nature of the weapon itself.

For it must be remembered—and this is a point to which I shall have to return several times—that the evolution of the forms of the sword, and of the theories concerning its most efficient use, are closely connected. It is, in fact, sometimes difficult to decide nicely whether the change in the shape of the sword was the result of a development of a theory; or whether new theories were elaborated to fit alterations in these sword shapes due to fashion or any other reason.

I have said that when systematic fence came over to England it was already much simplified; in fact, improvement in the art, from its earliest days down to the present time, seems always to have been in the direction of simplification. Yet, for more than a century from the appearance of the first real treatise, simplification never reached that point which would render impossible the belief in the undoubted efficacy of those secret foins, of that universal parry, of ineluctable passes, which every master professed to teach. These precious secrets remain long, among a certain shady class of swordsmen, an object of untiring study, carried on with much the same faith and zest as the quest of the alchemist for his powder of projection, or of the merchant adventurer for El Dorado. It is almost unnecessary to explain at this time of day that there can be no such thing as an insuperable pass, as a secret thrust or parry; every attack can be parried, every parry can be deceived by suitable movements. Yet there was some justification for the belief in the existence of secrets of swordsmanship in days when, as a rule, lessons of fence were given in jealous privacy; constant practice at one particular trick, especially with the long rapier, which required a great deal of muscular strength, might render any peculiarly fierce, sudden, and audacious stroke excessively dangerous to one who did not happen to have seen that trick before. Undoubtedly there was little in Elizabethan fencing-schools of what we understand in modern days by loose-play between the pupils: practice was almost invariably conducted between pupil and teacher alone, and thus the opportunities for testing any particular fencer's play were few. Such an opportunity would as a rule only occur on occasions of an earnest fight; and the possessor of a specially handy thrust, if it came off at all, would of course take good care that his opponent should not live to ponder over the secret. The secret, such as it was, remained. In this guise it was inevitable that an almost superstitious belief in "secret foynes" the *botte secrète* of certain practised duellists, should arise.

Be it as it may, there is no doubt that to wards the 16th century there were many free-lances in the mystery of arms who professed to teach, in exchange for much gold, strokes that were not to be parried. From one truculent personage, whom Brantôme mentions, Tappa the Milanese, you could learn how to cut (if it so took your fancy) both eyes out of your adversary's face with a *rinverso tondo*, or circular "reverse of the point." From Caizo, another Italian teacher, at one time much favoured by the French Court, lessons were to be had in the special art of ham-stringing. Caizo's *botte secrète* seems to have been nothing more nor less than a *falso manco*, that is a left-handed drawing out, at

the inside of the knee. But, as practised and tanght by him, it was infallible. This stroke has come down to us as *le coup de Jarnac*—a stroke be it said, which notwithstanding its bad name, was quite as fair as any in rapier fence. One Le Flamand, a French master in Paris, was reputed the inventor of a jerky time-thrust at the adversary's brows, which was a certainty. This special foyne, which was merely an *imbrocata* at the head, has become legendary in the fencing world as *la botte de Nevers*. We have our own legends about "the very butcher of a silk button," about which I should dearly love to speak, had I time: and this brings us to the first writer on the rapier in this country. Vincenzio Saviolo, the great expounder of that Italianated fence which was so obnoxious to the old masters, withal so much admired of Elizabethan courtiers; to the man, in short, who there seems to be much internal evidence to show was Shakespeare's fencing master.

Vincenzio was not the only foreign master of note established in London during the latter part of Elizabeth's reign. One, Signor Rocco, had, we hear, a very gorgeously appointed academy in Warwick-lane, near St. Paul's, where he coined money rapidly, at the expense of gulls and gallants alike. But this man came to grief ultimately in an encounter with the long sword with an English master of defence. Another popular teacher was a certain "Geronimo;" but he also met with a melancholy and premature end one fine morning by the hands of one Cheefe, "a tall man in his fight and natural English," says George Silver, the champion of the Corporation of Masters of Defence. Saviolo, however, seems to have remained unconquered, and I think I may devote a few minutes to the art as expounded by this most interesting swordsman, in order to show what were the principles of rapier fence as understood in its best days.

The fencing phraseology of Elizabethan times is highly picturesque, but with difficulty intelligible in the absence of practical demonstration. Without going too far into the technicalities, it must be pointed out that the long Elizabethan rapier, however admirably balanced it might otherwise be, was still too heavy to admit of quick parries with the blade. Thrusts, as a rule, were avoided either by ducking, or by a vault aside—*incartata*—or beaten away with the left hand, the hand being protected with a gauntlet or armed with a dagger. In fact, one may say that the chief characteristic of Elizabethan sword-play—as distinguished from what we now understand by fencing—was the concerted action of the left hand parrying while the right delivers the attack. Benvolio's description of Tybalt's fight is graphic:—

> "With piercing steel he tilts at bold Mercutio's breast,
> Who, all as hot, turns deadly point to point,
> And with a martial scorn, with one hand beats
> Cold death aside, and with the other
> Sends it back to Tybalt, whose dexterity
> Retorts it. . . . . . "

Of body-movements in Saviolo's days the most approved were: the *incartata*, just mentioned; the pass — the "passado," in the ruffling Anglo-Italian jargon — that is the passing of one foot in front of the other whilst delivering the attack; the *botta lunga*, or lunge; and the *caricado*, which was a far-reaching combination of the two.

Of systematic sword movements there were six: *stocata*, a thrust delivered with nails upwards; *imbrocata*, with the nails down; *punta-reversa*, any thrust delivered from the left side of the body; *mandritto*, a cut from the right; *rinverso*, one from the left; *stramazone*, a right down blow with the point of the sword.

The Italians were undoubtedly the leaders in this particular form of sport; but, towards the beginning of the 17th century, the Spaniards developed a peculiar school of their own, which for a short while was all the mode in England as well as in France. The last trace, be it said at once, of that school is now as extinct as the Dodo! Yet your Spaniard of cavalier days was undoubtedly a formidable duellist; but that was no doubt owing to the quality of the man, not of his art. The Italian's fence was artistic; the Spaniard's dexterity was tremendously scientific. In Spain were to be found typically those "Captains of Complements," who not only understood in their most intricate mazes the proper dependencies for the cartel, but also the mathematical certainties for the "reason demonstrative." These Spanish books are marvellously pedantic, one may as well say it, frankly ridiculous. Spanish masters instructed their scholars on mathematical lines, with the help of diagrams drawn on the floor within a circle, the radius of which bore certain cryptic proportions to length of human arms and Spanish swords. The circle was inscribed in squares, and intersected by sundry chords bearing occult but uncontrovertible relations to probabilities of strokes and parries. The scholar was to step from certain intersections to certain others. If this

stepping was correctly done the result was a foregone victory, if not—a veil had better be drawn over the rest of the story. "A villain," exclaims Mercutio, indignantly, "who fights by the book of arithmetic!"

Elizabethan comedies bring us an echo of its great expounder, the magnificent Carranza, the *primer inventor de la Ciencia de las Armas*, the writer of treatises so abstruse on "the first and second cause," in matters of honour and swording, that they have never been quite understood to this day.

We have heard Bobadil on this demi-god of the rapier in "Every Man in his Humour." The other great man in the annals of Spanish fence is Don Luis Pacheco de Narvaez. His name, among swordsmen, was also one to conjure with. We remember to this day mine host's comment in "New Inn" on the glories of past teachers: "They had their time, and we can say: they were. Don Lewis of Madrid is now the sole remaining master of the world." But, as I said, there is no doubt that, however artificial Spanish books of fence may be, Spanish swordsmen were redoubtable and Spanish rapiers were excellent as well as magnificent.

Perhaps the most curious matter in connection with the Spanish fence is that the fourth book published in the French language is in reality purely Spanish (and we have seen that the first was German, and second and third were adaptations of Italian treatises). This work, "*Académie de l'Epée de Girard Thibault, d'Anvers, &c.*," is indeed a monument; one of the biggest books ever printed, and beyond compare the biggest book of fence. It was issued in 1628 by the Leyden Elzevirs, and took fifteen years to complete. Nine reigning princes and a vast number of private gentlemen subscribed to meet its stupendous expenses. When it was at last completed, the author, Girard Thibault, of Antwerp, died. I have sometimes wondered whether his sudden death was caused by his realising at last the phenomenal silliness of his work.

This work was spoken of as a "monument." soon after that period rose an entirely new It may, in some respects, be looked upon as the funereal monument of the old rapier fence; for, school, one adapted to the use of a less portentous weapon, the small-sword of French pattern; a school destined to endure, and to lead to the perfection of our modern *escrime*.

The evolution of this new school is an instance of what I adverted to some time ago, namely, the influence of fashion upon the shape of the sword, and hence upon theories concerning it use. The French school of fencing may be said to owe its origin to the adoption, under the Grand Monarque, of the short court-sword in place of that arrogant, wide-hilted rapier of the older style. With a weapon of such reduced dimensions, of such reduced weight, the advantage of the dagger as a fencing adjunct ceased to be felt. The dagger, last Gothic remnant, disappeared accordingly, and there arose rapidly a new system of play, in which most of the defensive actions were performed by the blade alone; and, at the same time, the reduction in the size and weight of the weapon rendering the use of the edge almost nugatory in comparison with that of the point, all cutting action was ultimately discarded.

It is from that date, namely from the last third of the 17th century, that the sword, as a fighting implement, becomes differentiated into two very different directions. The military weapon becomes the back-sword or sabre; the walking companion and duelling weapon, becomes what we now understand by the small-sword. Two utterly different kinds of fence are practised; one, that of the back-sword; the other, what we would now call foil-play.

The magnificent old cut and thrust rapier still flourished, it is true, in parts of Italy and Spain; but by the end of the 17th century it had already become an object of ridicule to any person adicted to *bon ton*—and it must be remembered that *bon ton* on the Continent everywhere and even in Merry England, at that time, was French *ton*. The walking sword, fit for a gentleman's side, was, therefore, the small-sword of Versailles pattern. Its use had to be learnt from French masters of deportment; the old magniloquent rapier jargon was forgotton; French terms barbarised into *carte, tierce, sagoon, flanquonade*, and so forth were alone understood. In fact, French fencing, to your Georgian spark, became as indispensable an accomplishment as the fine Italianated foyning had been to the Elizabethan ruffler.

The new French fencing was, it must be owned, very neat, quiet, precise, and, if anything, even more deadly than the old fence. It was perfect, as a gentlemanly mode of fight, in short; and as well suited to the lace ruffles, to the high perruque, and the red heels of the "beau," as the long cup-hilted rapier had been to the booted and spurred "cavalier." It was an ideal weapon wherewith to decide contested points with all due decorum and

dispatch. The essence of its play was nimbleness of wrist—it required quickness of spirit rather than muscular vigour.

In connection with the invasion of French fencing in post-Restoration days, it is curious to note that precisely the same opposition was offered by the exponent of the national game that had been offered to the new-fangled Italian fence by the members of the old corporation.

During the Parliamentary period, as we have seen, the rapier and its attendant dagger had practically disappeared: they were not true warlike weapons, their chief virtue was for duelling or sudden rencounters. On this and on other grounds (such perhaps as that of their great beauty of form and their suitableness for admirable ornamentation) they were held to be malignant and meretricious. But the stout English backsword survived; and, with it, a very definite school of backsword play. Under the Merry Monarch the popular amusement of stage or prize-fighting with swords had become *à la mode*.

Courteous assaults at many weapons, but of course rebated, had been frequent functions under the auspices of the Corporation of Masters of Defence during the second half of the 16th century, and it is in such sword-matches on the scaffold that we may find the origin of our modern prize-fights at fisticuffs.

The first instance known of a challenge at sharps on the fighting stage is seen in a cartel sent by George Silver and Toby his son, as Champions of the Corporation of Masters of Defence, to the obnoxious "Signors" Saviolo and Geronimo. As a matter of fact, the latter, having apparently no wish to improve their excellent social position or to risk forfeiting it, declined this invitation to a public trial of skill. But the idea was right martial and pleasing to the English mind, and the fashion of prize-fighting took the firm hold it retained on English minds till stringent legislation, not so very long ago, was brought to bear upon it. Be it as it may, this prize-fighting with swords endured until middle Georgian days, when, under the impetus given to fistic displays then by the renowned Figg (who was at one and the same time the most formidable of English fencers and the first on our long list of pugilistic champions), back-swording became relegated to the provinces, and ultimately dwindled into our bastard single-stick play.

For graphic accounts of these gory stage fights we may look to various contemporary accounts of foreigners on a visit to England; among others, to that of one M. Jorevin de Rochefort, who seems to be much horrified by the blood-letting he saw in the bear gardens on the Surrey side; also to the pages of the *Spectator* and the "Diary" of the immortal Mr. Pepys.

But, to revert to fencing proper: although the broad-sword remained the true national weapon, nevertheless, for your man of fashion, the small-sword of French pattern was absolutely indispensable. "I am much in love with fencing," says young Squire Mockmode in Farquhar's 'Love and a Bottle,' "but I think back-sword is the best play." This was a sentiment which most thorough going Englishmen probably endorsed at heart, even in days when fashion required every man with a pretence to quality to learn the correct use of the slender blade he had to wear from some Frenchified master, such as Farquhar's Nimblewrist.

Fencing, in its restricted sense of purely thrusting play, was always an "academic" art in England. It had been so in Elizabethan days; it remained so in Georgian times; the only difference being that, in the former case, the contemptuously-admired foreigner was the Italian, in the latter the Frenchman.

Now what cause are we to ascribe to the extraordinary development which fencing, as a fine art, had received in France during the latter part of the 17th century? Beyond a doubt, it was the existence of a recognised normal school in the shape of an Academy of Arms. This "*Académie Royale des Maitres en fait d'Armes*" had had already a long existence. It had been instituted by Charles IX., had received fresh charters under Henry IV. and Louis XIII. But it was under the *Roi Soleil* that it assumed that powerful, that preponderating position, the effects of which are still shown in the present supremacy of French fencing.

In these islands the first great advocate and exponent of the new small-sword fence, as taught by the rising French school, was Sir William Hope of Balcomy, at one time Deputy Governor of Edinburgh Castle, who wrote a great number of quaint treatises of great interest to the "operative" as well as to the "speculative" fencer. Yet, oddly enough, Sir William Hope was instrumental in endeavouring to push through Parliament a Bill for the establishment of a Court of Honour, the office of which was to have been the deciding of honourable quarrels, if possible without appeal to fencing skill. The House,

however, being at the time excited and busy on the question of the union of Scotland and England, the Bill never became Act, and gentlemen, in consequence, continued to discuss their knotty points *sur le pré*.

To resume: since it began to be practised as a regulated art one may say broadly that fencing has passed through four main phases. The first might aptly be termed THE FRANKLY BRUTAL. It belongs to the early Tudor days of sword and buckler encounters, whereof, if the best theoretical treatises appeared in Italy, the sturdiest practical exponents were most probably found in these islands.

Then came what may be called the THE FIERCELY PICTURESQUE, coeval with the eager adoption by the ruffling community of the cavaliero mannerism, with all its fascinating bombast; with its antics and loud resounding Italo-Spanish jargon. There, may be discerned the dawn of fencing proper, which will fully arise when, in Caroline times, the outrageous length of the tucke will at last be sufficiently reduced no longer to require the dagger as a helpmate.

With the light, elegant and deadly small-sword we enter a new atmosphere, so to speak, on fencing ground. Suppleness of wrist and precision of fingering replace the ramping and traversing the heavy forcing play of the Elizabethan. The change is parallel with that in manners and in speech. It is now of vast importance when you deliver your *botte in high tierce*, your *flanconnade*, or your *glissade in sagoon*, or what not, to do so "with an air"—"This to your heart!" by all means, but as you live, with a smiling good grace! All this is of course very superficial. But to my mind that was the great age of fencing, since fencing must ever be a conventional game. It is the phase of powder and patch and *talons rouges*, the phase that I would call "THE GALLANTLY DECOROUS." If the "FIERCELY PICTURESQUE" was represented by Vincenzo Saviolo, this one was typified, albeit, perhaps, at a time when it was already somewhat on the wane, by the admirable *Angelo Tremamondo Malevolti*—in one word, by our Angelo.

In the early days of the "gallantly decorous" age men still fenced in play as they fought in earnest. But presently there appeared on the scene an implement destined to revolutionise the art and hopelessly to divide the practice of the school from that of the field. I advert to the fencing mask. Before this invention, small-sword play in the master's room was perforce comparatively slow, correct, sure, and above all deliberate. The long, excited, argumentative phrases of modern assaults were unknown; and so was the almost inevitably consequent scrimmage. But under the protection of the fencing mask a new school of foil-play evolved itself, one in which swiftness and inveteracy of attack and parry, ef *riposte*, *remise*, counter *riposte*, and *reprise*, assumed an all important character. And with this new style began to assert itself that recklessness of "chance hits," which, in our days, so markedly differentiates foil-practice from actual duelling.

This brings us to the other consideration of our subject: Fencing as a sport.

If anything were required to demonstrate that fencing has nowadays passed into the state of what may be called fine art in athleticism, it would be found in the separate existence of the method which French masters particularise as *le jeu du terrain*, as duelling play in fact, a play which differs as completely from academic foil-fencing as cross-country riding in an unknown district from the *haut école* in the *manège*. By fencing, nowadays, we have come to mean not simply fighting for hits with the foil, but that strictly regulated play which, being quite conventional, does not take accidental hits into consideration at all. This game requires for its perfect display a combination of artificial circumstances, such as even floors and featherweight weapons. Now, for the more utilitarian purposes of duelling, the major part of the fencer's special achievement and brilliancy has to be uncompromisingly sacrificed in the presence of the brutal fact that thrusts in the face or below the waist *do* count, insomuch as they may kill; that *accidental* hits in the arm or the leg cannot be disregarded, for they may, and do generally, put a premature stop to the bout. The "rub on the green" must be accepted, perforce, and often plays as important a part in the issue of the game as the player's skill. The fact, however, that in earnest encounters, all conventionalities which determine the value of a hit vanish, does not in any way justify the notion, prevalent among many, that a successful hit justifies any method of planting the same; and that the mere discarding of all convention in practical sword play is sufficient to convert a bad fencer into a dangerous duellist.

In both plays—in the highly polished, complicated and brilliant fence of the first class "fencer," as well as in the simpler and more

cautious operations of the practised duellist—the one golden rule remains, namely, that one, so quaintly expressed by M. Jourdain's *maître d'armes*, in Molière's comedy: Tout le secret des armes ne consiste qu'en deux choses, à donner et à ne point recevoir."

Now the point most usually lost sight of by sanguine and self-reliant scorners of conventionalities is that, although with the sword it may be comparatively easy at any time "to give," it is not so easy to "give without receiving." The mutual simultaneous hits—the *coup-double*—is, in fact, the dread pitfall of sword-play. And therefore, in courteous play, a hit has no real value, not only when it is actually cancelled by a counter, but when it is delivered in such a way as to admit of a counter. In short, it is the experience of ages and the careful consideration of probabilities, which have given birth to the various make-believes and restrictions that go to make sound foil-play. These restrictions are destined to act in the same direction as the warning presence of a sharp point instead of a button; and thus, as far as possible, to prevent those mutual hits—the *contretemps* of the old masters—which mar the greater number of assaults.

The proper observance of those conventions, other things being equal, distinguishes the good from the indifferent swordsman—the man who uses his head from him who rushes blindly where angels fear to tread.

In modern sword-play is seen the usual tendency of arts which have reached their climax of complication to return to their pristine simplicity. With reference to actual duelling, it is a recognised thing that it would be the height of folly to attempt, sword in hand, the complex attacks, the full-length lunges, the neat but dangerously weak parries of the foil; so much so that many have been led to assert that, for its ultimate practical purposes (which logically is that of duelling) the refined art of the foil, requiring for its perfection so many years of assiduous and methodical work, is next to useless. It is alleged, as a proof, that the most successful duellists have, with but few exceptions, happened to be indifferent performers on the fencing floor. Some even maintain that a few weeks' special work in that restricted—very restricted—play, which alone can be considered safe on the field of honour, will produce as good a practical swordsman as any who have walked the schools for years.

Nothing can be further from the truth, were it but on the ground that the greater includes the less; that the foil-fencer of standing, who can perform with ease and accuracy all the intricate movements of the assault, who has trained his hand and eye to the lightning speed of the well-handled foil, must logically prove more than a match for the more purely practical, but less trained, devotees of the *epée de combat*. The only difference for him in the two plays is that the latter is incomparably slower in action, simpler; that it demands, above all things, patience and caution; and especially that, instead of protecting his breast only, he must beware of the wily attack, or the chance hit, at *every* part of his body, whereas with the foil he need only think of his breast.

The modern teacher of the purely practical sword-play, curiously enough, returns to the older notions of marches and retreats, of heavy crossings and parries with powerful positions. He attaches special value to time thrusts, darted at the nearest part of his adversary's body, even at the head—a stroke which reminds one of Le Flamand's *Botte de Nevers*—or at the knee—which inevitably recalls that *falso manco* which gave the victory to Jarnac. Like the masters of ancient times, also, whose ideas always bore on the safest method of despatching an enemy without reference to æsthetics, the modern expounder of strict duelling play devotes uncurtailed consideration to the most approved ways of combatting different idiosyncrasies. This subject, by the way, was dealt with at full length, and very quaintly, in Sir William Hope's treatises on practical swordsmanship. By different idiosyncrasies, are meant, among others, the wiry and the phlegmatic, the reckless and the restrictive, the artistic and the ignorant.

In the most up-to-date phase of swordsmanship as applied to the vindication of personal honour there is a distant but quite perceptible similarity of purpose to that first, which I have called the *Frankly Brutal*. In contradistinction to its more immediate predecessors I would characterise it as "STRICTLY BUSINESS." In the eyes of some, but specially of the romantically disposed in such matters, it might in a way be looked upon as the *reductio ad absurdum* of the once gallant game. And yet it would be absurd to cavil at it. And what is more, it is the obvious duty of the fencer, however truly devoted to the delights of academic foil play, to make himself acquainted with all its possibilities. For there would be something intensely ridiculous in the position of a man

who was held to be a great adept with the foil, and who yet allowed himself, when it came to the point, to be disabled by a mean thrust at the hand or the knee. Whatever may be the academic value of a hit with a pliant and well-buttoned foil, obviously with a sharp sword point every hit is good, whether merely lucky or superiorly devised, if it proves disabling. Your complete swordsman must be one who can place his hits with a gallant good grace, but one also who will not allow a clumsy opponent to prevail himself on any hap-hazard thrust.

Gallant bearing, disdainful valour, all that is very well in its way, "but the thing, Sir, is to hit your man without being hit yourself." That is the wisdom of ages. And further, especially in these days, the thing is not so much to kill your man—who cares about that now we are not savages?—as to get through your duel satisfactorily to yourself, to your seconds, and the authorities. Draw blood and honour is satisfied.

Now all this demands much system and caution, and, as I have said, much patience. Indeed, we often see in the ultra modern *epée* play a good deal of what our Elizabethans would have called "very peaceable wars," ending with much display of strategy and reticence in a stealthy stab on the hand or at the advanced leg. But, after all, a transfixed wrist or knee will place your man *hors de combat* as surely as the most dashing "This to your heart!"

In England at the present day, however, it is with fencing as a sport that we are mostly concerned. And an excellent sport it may be made, if cultivated in the right spirit; if the conventions of the game are scrupulously respected; and, above all, if consideration of *form* is placed over and above every other. It can never be to much insisted upon that in foil practice, where the factor of personal valour or of nerve plays no part, the actual hit is quite second in importance to the method of its delivery, to the neatness of execution; to *form*, in short. Unless such a conception of fencing, as a sport, obtains, all is lost. The game inevitably palls in a very short while, its futility becomes obtrusive; and inane it undoubtedly becomes, not only as a game, but as a practice in the art of fight generally. Rough, unregulated foil-play can never he more than an unseemly struggle with feeble-looking weapons; whereas, on the other hand, good fencing should be the perfect instance of the cardinal fighting qualities — complete self-control in the midst of intense keenness and expectancy, swift decision following cool foresight, minimum of motion and effort resulting in maximum speed.

To many it must often seem a matter of wonder that among Englishmen, who take the lead in all matters of sport and exercise, there now should be found so few swordsmen of note. The reason, however, is not far to seek. It is not, as it is so often repeated, that Englishmen must take their exercise in the open air. Boxing and gymnastics are not practised in the open air, and at such games we more than hold our own. The plain reason is that we have no school. We have plenty of fencing schools, but we have no English school.

There is nothing peculiar to the Frenchman, or any other Continental, to predispose him to sound swordsmanship. Now we have seen that before the 17th century the Frenchman had to learn his sword-play from Germans or Italians or Spaniards; that, in the 18th the French, on the other hand, sent masters all over the world. This was the result of the simple fact that in Italy, in Spain, and in Germany there had existed central schools of swordsmen where a high standard of excellence was maintained by keen competition and severe supervision from recognised masters. In the same manner, as long as our own Corporation of Masters of Defence existed, England could boast as great a national superiority over France in sword-play as she does now in pugilistic or other athletic pursuits. These central schools disappeared, whilst, on the other hand, the French *Académie d'Armes* was fostered. It endures still under a revived form. Hence the lasting real superiority of the French fencing master.

During the last twenty years normal schools of fence for the training of masters have been established in Italy, with the result that Italian fence rooms can boast, at this moment, a number of men of the sword who run the best French professionals very close.

We, unfortunately, have no recognised academy, no place where a man must give proof of his ability before he can be allowed to teach others. As a result, with very few exceptions, fencing is badly taught. The admirable capacity of foil-play for the training of eye and muscle is misunderstood. Fencing is voted uninteresting, and in consequence, is much neglected. More is the pity; for although the original purpose of systematic sword-play—with us at least—is a thing of the past, fencing

as a refined and concentrated form of athletic exercise is admirably suited to a numerous class of men to whom other physical pastimes may be unavailable.

After the reading of the paper, Mr. Castle gave a demonstration of various styles of swordsmanship as exhibited in fencing and duelling. Mr. Castle was assisted by Monsieur Fontaine, Professor at the London Fencing Club, and by Mr. W. H. C. Staveley. Specimens of historical swords were shown by Mr. Castle and by the Chairman. Drawings by Mr. Percy Macquoid were also kindly lent by Colonel the Hon. William Le Poer Trench.

DISCUSSION.

The CHAIRMAN was sure that the audience had all followed Mr. Egerton Castle with the utmost interest. He felt honoured that Mr. Castle had been able to make use of some drawings of his that he made some years ago for the *Graphic*. Had he known that they were one day to be put to the severe test of being enlarged to the size they were on the screen he might have been inspired to draw them better. It was difficult for the present generation to realise how important a part a thorough knowledge of swordsmanship formerly played in a man's education. Mr. Castle had very clearly and ably described all the different methods of fence, which altered as the necessities of the period prompted. Although the fencing of to-day with the *épée* had been probably brought to a finer and more scientific point than that of any other period, there was very little doubt that the duellist of the seventeenth and eighteenth centuries would prove a very awkward gentleman to settle. Fighting in those days was one of the recognised amusements of a gentleman, and although it was a form of humour that was no longer fashionable, the interest in the skill and art that it called forth was sometimes apt to make one forget how very serious and frequent was its occurrence. As a proof of the rage for duelling that existed it was a well-known historical fact that during the reign of Henry IV., in France alone 4,000 gentlemen were killed in duels, while 14,000 pardons to duellists were granted in the same reign. It only remained for him to move a hearty vote of thanks to Mr. Egerton Castle for the pleasure and instruction he had afforded that evening.

The vote was carried unanimously.

Miscellaneous.

A CONTRIBUTION TO THE EARLY HISTORY OF DYNAMO-ELECTRIC INVENTIONS.

A little-known paper, published as far back as 1851, in the leading journal of physical science in Germany —the *Annalen* of Poggendorff*—contains a very remarkable account of some researches on the excitation of magneto-electric machines, which are of great interest even to-day. The author, Dr. Sinsteden, was discussing the problem how to improve magneto-electric generators, and in this paper he describes a method which produced an essential augmentation of their power far beyond anything previously attained. He begins by referring to the still earlier efforts of Stöhrer, who had increased the number of magnet poles from two to six and contrasts this with the "colossal" machine of Woolrich, which, while it had eight poles, had double as many armature coils or inductive coils as polar fields, together with a commutator which so changed the connections as to obviate discontinuity in the current. He then mentions how he has applied the same plan to a two pole magneto-machine, providing it with an armature having four inductive coils. He tested it by the amount of gas its current would evolve in a voltameter (namely, 1⅔ cubic inches of mixed gas per minute). When he applied its current to excite electromagnets, he found that these were much more powerful than the original steel magnet of his first machine. Dr. Sinsteden thereupon makes the following remarks upon the excitation of the field-magnets of generators:—

"I cannot here forbear to draw attention to the circumstance that the steel magnet of my apparatus which has a constant portative force of 200 pounds, generates an induced current which, on its own part, excites an electro-magnet to more than double this portative force. This circumstance is, indeed, in itself noteworthy; but it appears to afford a means to augment up to an enormous degree ['bis ins Ungeheure'] the magneto-electric currents from a *single steel magnet*. For if one causes to rotate in front of the poles of this electro-magnet excited by the magneto-electric revolving apparatus, another four inductive coils, the iron core and windings of which were designed for a magnet with an attracting force of 500 pounds, then one would obtain from these four inductive coils a current the strength of which would evidently be at least double as great again as that of the first apparatus, and which in the voltameter would evolve six cubic inches of explosive gas in a minute, and would excite up an electro-magnet of proportional size to a portative force of 1,000 pounds. Nothing prevents one's causing to rotate in front of this second electro-magnet another four proportionately large inductive coils, the induced current of which excites a third electro-magnet, and again putting inductive coils opposite this, and so continuing this arrangement as long as one still controls mass and weight. In this way, one would very soon obtain induction currents which would leave far behind them the currents of the most gigantic hydro-electric apparatus of Children and of Hare. Their excitation would cost nothing, except the power which is necessary to set the inductors into rotatory

* Pogg: Ann. lxxxiv., 186 (1851).

motion; and since in these electro-magnets no change of polarity occurs, they remain much more constantly charged, wherefore there would occur no disturbance by reason of the coercive force of the iron, and no disturbing reaction of the iron upon the spirals, and of the spirals upon the iron. These magneto-electric currents thus increased to an enormous strength would then be applicable to *power-machines* [*i.e.* motors] in the place of costly hydro-electric currents, over which they would have the important advantage that they occasion no current costs through the consumption of zinc and acids.

"Copper wires eight inches long, rather thicker wires of steel six inches long, formed into little spirals by rolling on a knitting-needle, are immediately made to glow through their whole length by the induced current of the machine, and melt off or burn scattering sparks. Platinum wires six inches long 1-18th of a line thick, wound in little spiral tubes, glow white hot throughout their length and give a blinding light. They frequently melted off, but could very easily be fused together again. The incandescence of all these wires always began from their middle whether the current had a continuous or an alternating direction."

After further narrating some experiments on the fusion of garnet and of porcelain, Dr. Sinsteden continues:—"As I had not at my disposal different thicknesses of platinum wire in order to form out of them a small tube which should reach just the highest white heat without melting, I attained this end by making a platinum wire spiral tube out of the wire which melted too easily, and which I dipped in a thin milk of lime and dried and incandesced in a flame. The thin coating of lime behaved quite well upon the platinum wire, which now no longer fused on repeated use, and as it appeared to me emitted a still more dazzling light than a dull platinum wire.

"These researches which were all made with one and the same combination of inductive spirals, which, by the way, can be operated in three different ways, may be regarded as a fair sample of the efficacy of my new machine; they show that a *one-magnet* machine may yield much more than one had expected of it, and it might therefore be of interest to many to learn to know the precise arrangement of it."

The article gives a description of the details of the machine, and, in particular, of the commutator which was arranged to bring one set of coils into operation when another set was going out of operation, thereby furnishing a continuous current instead of a merely rectified one, and which also had auxiliary attachments for collecting alternating currents at will, or for making momentary contacts.

It seems strange that so striking an announcement of the method of separate excitation, of the concatenation of machines to produce an indefinitely great increase in the magneto-electric currents, of the application of dynamic power to drive generators in order to provide currents for driving motors, and of the application to incandescent lighting by platinum spirals covered with pyro-insulating materials, should have claimed so little notice. Moreover all this was published in 1851, five years before the invention of the Siemens' armature, the introduction of which gave so considerable an impulse to the use of magneto-electric machines.

Correspondence.

AUTOMATIC COUPLERS.

There is, unfortunately, no means of answering Mr. T. R. Chalmers's very pertinent enquiry when he asks for the number of shunting operations and comparative ton-wagon loads on American and British railroads. Neither country gives returns by which any such comparison can be arrived at. Mr. Chalmers's reference to "Accidents from crossing and recrossing of the rails to the various sidings" by shunters, may be read as though he concludes such accidents were included in the coupling accident tables I give in my paper. These tables deal *exclusively* with accidents occurring in the act of coupling or uncoupling vehicles. There are no less than eighteen other columns in the returns which record accidents to servants connected with shunting—*i.e.*, concerned in the movement of vehicles, and in these columns appear not a few casualties year after year, for which the present methods of coupling and uncoupling are directly or indirectly responsible, but which never find place in the column allotted to coupling and uncoupling.

The very work of moving vehicles by hydraulic capstans would seem to have nothing to do with coupling accidents, but so interlaced are all shunting operations with coupling and uncoupling vehicles, that each one of these eighteen other columns, which record about 3,500 accidents every year, will be lighter when automatic couplers are universal on British railways. The time at my disposal did not admit of more than a glimpse of the far-reaching extent of this subject, which not a railway man in this country yet fully understands.

T. A. Brockelbank.

Obituary.

Sir James Westland, K.C.S.I., whose death occurred on the 9th inst. at Weybridge, was a distinguished member of the Indian Civil Service, his principal work in that capacity having been performed in connection with the Financial Department of the Supreme Government. He was appointed Chief Commissioner of Assam in July, 1899, but retired from the service in October of the same year,

and made his home in New Zealand. As a financier he enjoyed the confidence of the commercial community in India, and when four years after his retirement he was induced to return to India for the purpose of succeeding Sir David Barbour as Finance Minister, the appointment gave general satisfaction. He resigned his position as a member of Lord Curzon's Government in March, 1899, and shortly afterwards was appointed to a seat in the Council of the Secretary of State for India. Sir James Westland joined the Society in 1897, and was amongst those who took part in the discussion on Mr. J. Barr Robertson's paper on Currency at a meeting of the Indian Section a few weeks ago.

Colonel Edmund Armitage Hardy.—Colonel Hardy, who acted for some years as Secretary of the Indian Section of the Society, died on the 12th inst., at Clifton, in his 80th year. Colonel Hardy's connection with the Society commenced in 1873, and continued to 1884, when he was obliged to give up the work in consequence of his leaving London. During these years, many valuable papers were read in the Section, which profited greatly by Colonel Hardy's energy and ability. He was educated at Rugby, and joined the Indian Army in 1841. As a lieutenant, he served with credit under Sir Charles Napier, in Sind. In 1848-9 he served in the Mooltan campaign, for which he received the medal and clasp. He served with distinction through the Mutiny, and was strongly and specially recommended for his services at Nusserabad, where the command of the regiment (1st Bombay Cavalry) devolved on Captain Hardy after his senior officers had been killed. He himself was severely wounded, but, in the words of the official report, "he continued to command his regiment with great tact and judgment during a most trying period." After the Mutiny he commanded the 4th Regiment of Sind Horse, and later joined the 21st Hussars (now 21st Lancers). His services in India continued until 1870, when he retired with the rank of Honorary Colonel.

General Notes.

Liège Exhibition, 1905.—Information has been received from the Board of Education respecting a Universal and International Exhibition, under the patronage of the King of the Belgians, which will be opened at Liège, in the month of April, 1905, and will continue for at least six months. The Exhibition will include artistic, scientific, industrial, commercial, and Colonial sections. The Colonial section will include an exhibition of the Congo Free State. A park will surround the buildings, and the Exhibition will occupy a total area of 45 hectares (111 acres). It is proposed to reserve a portion of the site for a reproduction of Old Liège, when the monuments and examples of architecture of the city of the Prince Bishop will be seen. The Exhibition will be treated as a bonded warehouse, foreign goods intended for exhibition being allowed provisional duty free importation, subject to being afterwards re-exported.

MEETINGS FOR THE ENSUING WEEK.

Monday, May 25...Farmers' Club, Salisbury-square Hotel Fleet-street, E.C., 4 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. 5 p.m., General Monthly Meeting.
Engineers, in the Theatre of the United Service Institution, Whitehall, S W., 7½ p.m.
Scottish Society of Arts, 117, George-street, Edinburgh, 8 p.m.
Chemical Industry (London Section), Burlington-house, W., 8 p.m. Messrs. J. H. Coste and E. T. Shelbourn, (1) "Neatsfoot Oil." (2) "The Nitric Acid Test for Cotton Seed Oil."
Linnean, Burlington-house, W., 3 p.m. Annual Meeting.

Tuesday, May 26...Royal Institution, Albemarle-street, W., 5 p.m. Prof. E. J. Garwood, "The Work of Ice as a Geological Agent." (Lecture I.)
Medical and Chirurgical, 20, Hanover-sq., W., 8½ p.m.
Photographic, 66, Russell-square, W.C., 8 p.m.
Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. W. Bateson, "The Present State of Knowledge as to the Inheritance of Colour in Fancy Rats and Mice." 2. Mr. G. A. Boulenger, "List of the Batrachians and Reptiles collected by M. A. Kobert at Chapadá, Matto Grosso." (Percy Sladen Expedition to Central Brazil.) 3. Mr. Edgar A. Smith, "Note on some *Bulimulidæ* from Matto Grosso." (Percy Sladen Expedition to Central Brazil.)

Wednesday, May 27...Geological, Burlington-house, W., 8 p.m.
Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.
British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

Thursday, May 28...Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Royal Institution, Albemarle-street, W., 5 p.m. Professor J. A. Fleming, "Electricel Resonance and Wireless Telegraphy." (Lecture I.)
Electrical Engineers, 92, Victoria-street, S.W., 5 p.m. Annual Meeting.

Friday, May 29...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. His Serene Highness Albert, Prince of Monaco, 'The Progress of Oceanography."

Saturday, May 30...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Silvanus P. Thompson, "The 'De Magnete' and its Author.' (Lecture I., "The Book.")

Society of Arts Journal.—The executors of a deceased member have offered to present to the library of any institution connected with this Society a set of *Journals* (unbound) from 1870 to 1903. The sets are nearly complete, and any deficiencies will as far as possible be made good by the Society. Applications to be made to the Secretary of the Sciety of Arts.

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No. 2,636. Vol. LI.

FRIDAY, MAY 29, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

THE ALBERT MEDAL.

The Albert Medal for the year 1903 has, with the approval of His Royal Highness the Prince of Wales, President of the Society, been awarded to Sir Charles Augustus Hartley, K.C.M.G., in recognition of his services, extending over 44 years, as Engineer to the International Commission of the Danube, which have resulted in the opening up of the navigation of that river to ships of all nations, and of his similar services, extending over 20 years, as British Commissioner on the International Technical Commission of the Suez Canal.

CONVERSAZIONE.

The Society's Conversazione will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, June 30th, from 9 to 12 p.m.

The programme of arrangements will be announced later.

Each member is entitled to a card for himself (which will not be transferable), and a card for a lady. These cards will be forwarded in due course. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the date of the Conversazione. On that day the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Tickets will also be supplied to non-members on presentation of a letter of introduction from a member.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

Proceedings of the Society.

INDIAN SECTION.

Thursday afternoon, April 23, 1903; Sir William Lee-Warner, K.C.S.I., in the chair.

The Chairman expressed his regret that the Earl of Lytton, who was announced to take the chair, was unable to be present owing to illness. It seemed altogether superfluous in that Society to introduce any Birdwood, for members regarded the family as part of themselves, and especially was it unnecessary to introduce Mr. H. M. Birdwood, as he had previously addressed the Society on the subject of plague. Mr. Birdwood had served in the Province of Sind in the highest capacity possible in his branch, *i.e.*, as Judge of the Sadar Court and Judicial Commissioner. Wherever he had served he had left behind him the truest regrets at his departure.

The paper read was—

THE PROVINCE OF SIND.

By H. M. Birdwood, C.S.I., M.A., LL.D.

Contents:—Area and Population of Sind—Physical Features and Rainfall — The Indus—Origin of the names "Sind," "Hindu," and "India"—Irrigation Canals and Colonisation—Vegetation and Scenery — Fauna — Railways and Imperial Defence—Aryan Influence in Sind—Invasion of Alexander the Great—Prevalence of Buddhism; Arab Invasion—Spread of Mohammedanism; Turki and Afghan Invasions—Subsequent History—The Buried City of Brahmanabad—Birth of Akbar at Umarkot; First employment of Sepoy troops in India—British Rule.

It will not be possible for me, within the time at our disposal, to present a detailed description of the province of Sind, of its physical features, its flora and fauna, its people, its literature, its history, its arts and manufactures, and its progress during British rule. I can only offer a few contributions towards the illustration of this many-sided subject in some of its aspects, a few personal impressions—my own, or those of others—and a few facts more or less obvious. Some good photographs of scenes and objects of interest, for which I am indebted to friends, will also be thrown on the screen; and these, I hope, will be appreciated by all now present, whether they have visited Sind or not.

Area and Population of Sind.

Relatively to other Indian provinces, Sind occupies a small space on the map, as will be apparent from the forest map of British India, now on the screen, the shaded parts of which show the forests on the great mountain ranges and on the banks of some of the great rivers. Thus the course of the Indus through Sind is indicated by the dark curved line on the extreme west; but that line is only one-third of the whole distance travelled by the Indus from its source on the northern slopes of the Himalayas to the sea. The Sind section of the Indus, if all its windings be reckoned, is 580 miles long, but, as the crow flies, the distance from Kashmor, where the Indus enters Sind, to the southernmost point of its delta, is only 360 miles, or a little more than the distance between London and Glasgow. The average breadth from east to west is 170 miles. Including the Native State of Khairpur, the area of Sind is 53,166 square miles. It is a little smaller than Assam, and a good deal smaller than the Panjab, or the United Provinces of Agra and Oudh, or the Central Provinces, or Burma. Its area is about one thirty-third of the whole area of India, including the Native States, and about one-twentieth of the area of British India. That is, it is about as large as England, with a third of Wales added to it. Its population, including that of Khairpur, is 3,410,223, or about twice that of Wales.

Physical Features and Rainfall.

The rough sketch map which will now be thrown on the screen shows that a considerable part of the country to the west of the Indus is covered by parallel ranges of the Khirthar or Hala Mountains, which rise to a height of 7,000 feet above the sea, and the Pabb hills, which meet the sea at Cape Monze to the west of Karachi and rise to a height of about 2,000 feet. All this part of Sind is rocky and barren. In the eastern districts, there is a wide tract of sand-hills, which are outlying portions of the Thar or "Indian Desert" of Rajputana; and between the two unfertile regions there is a rich alluvial plain, through which the Indus forces its way.

The rainfall is scanty throughout Sind, as it occupies a neutral zone between two extensive monsoon areas, and derives no appreciable rain supply from either. The south-west monsoon current, which carries with it an annual rainfall of 280 inches to the Western Ghâts of the Malabar coast, ceases to be rain-producing at Lakhpat, in Cutch; and the north-west monsoon, which freely waters the country to the west of the Khirthar mountains, similarly fails at Karachi. The average annual rainfall for the Karachi district does not exceed 8 inches, and this is a higher rate than for any other district in Sind, though it is exceeded sometimes in particular places.* In some places there is no rain for two or three years successively, and then there is a whole season's fall in two or three days.

The Indus.

For agricultural purposes, however, all such defects and irregularities are made good by the waters of the Indus on all lands which can be reached by irrigation. So long as the overflow is duly controlled the food-crops are assured. The inundations are indeed irregular, but they never fail everywhere at the same time, and widespread famine is, therefore, unknown in Sind. The conditions suggest those of Egypt and the Nile; and strangely enough, the ancient poets and geographers believed that the continent of India was in some way connected with Egypt, and even Alexander the Great, whose navigation of the Indus has been described as rather a geographical expedition than a campaign,† when he saw crocodiles in Sind, was convinced that a voyage down the Indus would bring his army to Egypt and the Nile, because there are crocodiles there also!‡ The argument would have appealed to Fluellen, and helped to relieve him of any doubt as to the correctness of his famous comparison of the river Wye with the river in Macedon, for, as he said, "there is salmons in both." But, certainly, the Indus is to the Sindhis what the Nile is to the people of Egypt. It means life, and competence, and content. It fertilises the land, and is itself well stocked with wholesome fish, the best known being the *pala*, or Indus salmon,—the *hilsa* of the Ganges. For many centuries it has afforded a highway for navigation. After receiving the accumulated waters of the Panjab, near Mithankot, at a distance of 490 miles in a direct line from the sea, its width extends to several miles, and

* "Annual Irrigation Revenue Report, Sind, 1900-1901," p. 58.

† Professor Mahaffy's "Alexander's Empire," p. 36.

‡ Sir H. M. Elliot's "History of India," Vol. I., p. 514. In quoting the authorities for this statement, Sir Henry Elliott considers it fair to remark that "such ignorance is not reconcilable, either with the general arrangement of Alexander's plans, or with the real geographical knowledge which his inquisitive mind must have imbibed."

is seldom less than 2,000 yards. Thenceforward, it is not fed by any great tributary, but, on the contrary, is tapped by many canals (the courses of some of which are shown on the map), and becomes narrower as it flows on. But even in Sind its average width, in the low season, is one-third of a mile, and its depth varies from 4 to 24 feet. Its delta covers 3,000 square miles, and its mouths extend along the coast for 125 miles.

Those who know the river best can soonest understand the fascination it has for centuries exercised on the minds of the people. And indeed for others, beyond the limits of Sind, ourselves included, whose claims to an Aryan descent are not too indistinct, its traditions must always possess a reasonable interest. It was the steady supply of water by the rivers of the Panjab and of Upper India which led the wandering pastoral Aryans to settle there as agriculturists ; and so the great rivers which induced this process, "perhaps the most important step," as the late Sir W. Hunter has said, "in the progress of a race," were praised by the Vedic poets. For a like reason, Sind was invaded by the Aryans, probably from the north, but possibly also from the south-west, by a route to the south of the Baluchistan deserts ; and on the banks of the Indus itself some of the hymns of the Rig Veda were undoubtedly composed. In some of these, the Indus, under the name of "Sarasvati" (which Mr. Ralph Griffith, in these particular hymns, identifies with the Indus), is described as "the mightiest" and "most divine of streams," "laden with sweets and dropping oil," a "sure defence," and a "fort of iron,"* and as "rich in mares,"† as Upper Sind still is. And elsewhere, under its usual name of "Sindhu," the Indus is spoken of as a mother, "animating all,"‡ and yet, once more, we are told of the Sindhu, the "lord and leader of these moving floods," that§

"His roar is lifted up to heaven,
He puts forth endless vigour with a flash of light.
Like floods of rain that fall in thunder from the cloud,
So Sindhu rushes on, bellowing like a bull.
Like mothers to their calves,
Like milch-kine with their milk,
So, Sindhu, unto thee the roaring rivers run.

* * * * *

Flashing, and whitely-gleaming in her mightiness,
She moves along her ample volumes through the realms,
Most active of the active, Sindu unrestrained,
Like to a dappled mare, beautiful, fair to see.
Rich in good steeds is Sindhu, rich in cars and robes,
Rich in gold, nobly fashioned, rich in vigorous mares.

* * * * *

So have I praised its power, mighty and unrestrained,
Of independent glory, roaring as it runs."

* Griffith's "Hymns of the Rigveda," Vol. III., pp. 117, 116, 118.

† *Ib.* Vol. II., p. 410.

‡ *Ib.* Vol. IV., p. 229.

§ *Ib.* Vol. IV., pp. 251, 252.

The Indus has lost none of its "independent glory" and "mightiness" since these lines were written, possibly 3,000 years ago ; and, to this day it is no light matter to restrain its "endless vigour" and vagaries, and to apply its "ample volumes," as completely as may be, to the public use and service. But the task has been attempted by the officers of the Irrigation Department, to the great gain of the people, as we shall presently see.

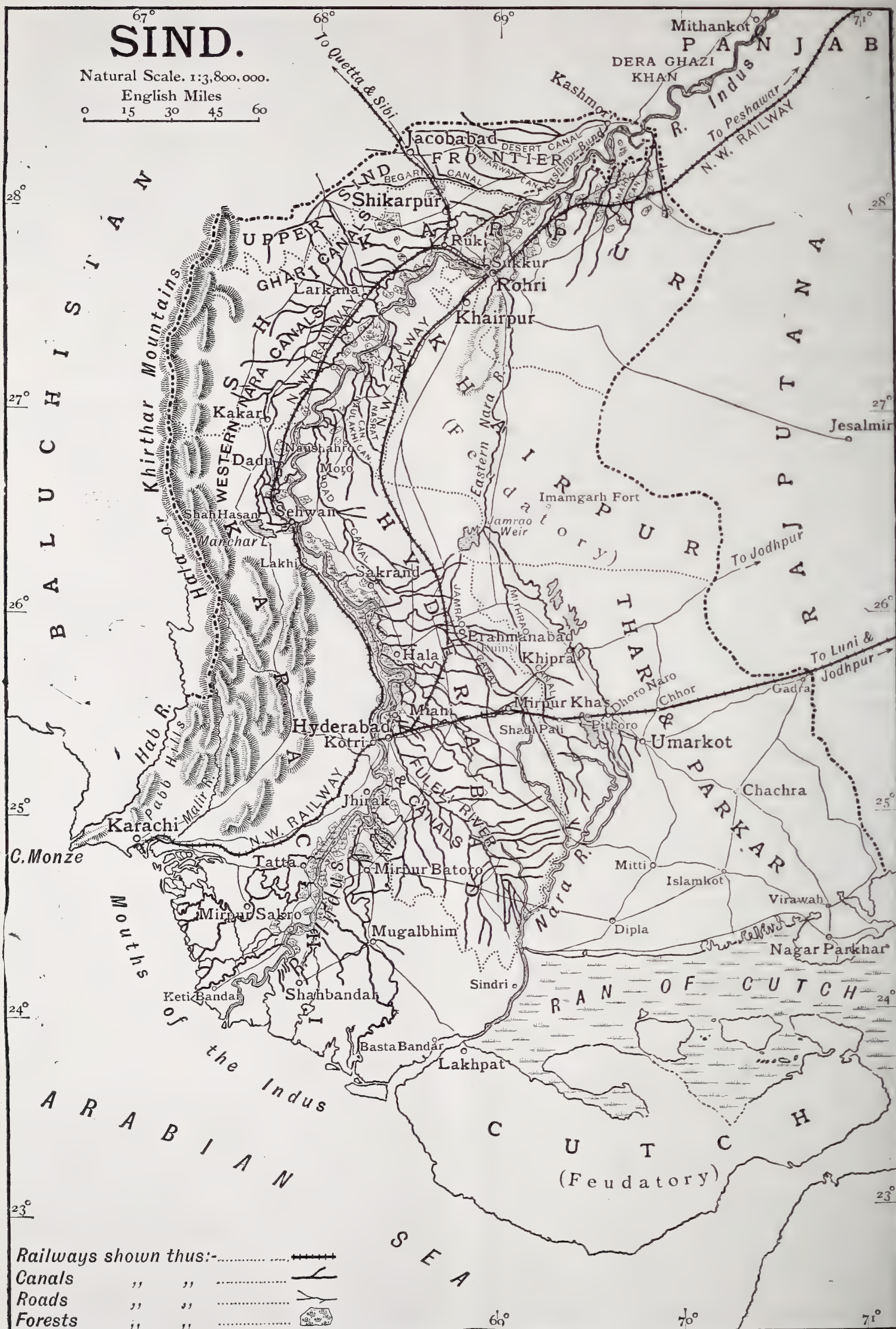
Origin of the Names "Sind," "Hindu," and "India."

With such a wealth of song to spread its fame, it is not to be wondered at that the Indus achieved the distinction, not only of giving its name to Sind, but of originating the word "Hindu" also, the letters "s" and "h" in the two words being interchangeable ; and it was probably also one of the seven rivers—the "Sapta Sindhavas*" of the Rigveda—from which "the land of the seven rivers"—the "Bharata varsha," or Bharat's Continent—took the name of "India" by which it became known to the Persians, the Greeks, the Romans, the Jews in Babylon, and the modern world. The late Professor Cowell described the Persian word "Hindustan," which was introduced from the same source by the Mohammedans, as "an interesting relic of Vaidik times," and pointed out that the land of the "Sapta Sindhavas" re-appears as the "Hapta-Hendu" of the Zend, as the "India" of the Greeks, who obtained the word from the Persians and passed it on to the Romans, and as the "Hoddu" or "Hondu" of chapter I., verse 1, of the Book of Esther, where, according to the Authorised Version, it is written that Ahasuerus reigned "from India even unto Ethiopia.†"

It is remarkable, however, that both in Arabic and Persian the word "Hindu" means "black" and "a robber," and in these senses it is certainly inapplicable to the fair-skinned Aryan householders and cultivators of the soil. An Indian friend, an accomplished orientalist, explains this perverted use of the word by the circumstance that the Kerks, a hardy aboriginal race from Sind, who found their way

* See Griffith's "Hymns of the Rigveda," Vol. II., p. 140.

† Note to Professor Cowell's Edition of Elphinstone's "History of India," p. 147.



Walker & Cockerell sc.

to the Euxine, and, by reason of their depredations along the coast of the Persian Gulf, were a terror to the Persian monarchy, "even in the days of its most absolute power," were dark-skinned pirates who called themselves Hindus. Their "nautical habits," according to Sir Henry Elliot, have "been inherited by generations of descendants" and their inveterate addiction to piracies, which, in A.D. 711, led to the Arab conquest of Sind, has only now been eradicated by the power of the British.*

Irrigation Canals and Colonisation.

The Indus at its source is 16,000 feet above the sea-level. At Attok, it is still 2,000 feet above the sea. For the greater part of its course it is, therefore, a rapid river, and is always bringing down with it, from the mountains, a vast quantity of silt and mud and gravel, which, when it slackens its pace over the lower levels of the Sind Valley, it deposits on its bed, which, thenceforward, is always rising. If the banks of the river, in its lower reaches, were not artificially raised and strengthened at all weak points, a great part of Sind would become an uninhabitable swamp. There is a perpetual demand for the watchful care of an expert staff of engineers, not only to maintain protective works, but also, as an engineer in charge of one of the great canals once put it to me, to "feel the pulse" of the river, as every rise and fall of its waters is telegraphed to the canal officers from different stations on its course, during the annual melting of the snows in the Himalayas and Afghanistan; for, on a right forecast of the time and volume of each coming flood depends the due regulation of water to the great system of canals on both banks of the river, which help the cultivator to sow his seed, and reap his crops, and pay his dues, regardless of the rainfall. During the past 20 years the policy of extending irrigation works in Sind has been vigorously pursued, and a large amount of capital has been invested. For instance, on the Jamrao Canal a sum of more than £490,000 has been spent. The idea of this canal was suggested many years ago, but no definite proposals were adopted until Sir Charles Pritchard became Commissioner in Sind in 1888. It is a perennial canal in the Hyderabad district, and a small section of it yielded an income of £20,000 in the first year after it was opened. The Nasrat, Naulakhi, and Dad canals have also been extended and improved at a cost of about £300,000. A stable supply of water has been given to the Rohri district by the Mahi canal. The Pritchard canal has supplemented the Western Nara. A drainage cut has been made at the tail of the Fuleli, which is now a perennial canal, and the southern part of the Hyderabad district is no longer an unhealthy swamp; and the Unharwah and the Desert canal, in the extreme north of Sind, have been enlarged, so that there is hardly any culturable land now left waste on the Upper Sind frontier. The total expenditure on canals to the end of 1900-1901 amounted to £1,705,666, and by that time the total mileage of completed canals amounted to 6,596 miles, the aggregate length of main canals being 2,626 miles, of branch canals 3,613 miles, and of distributaries 357 miles. The navigable channels on these canals extended to 1,794 miles.* Both banks of the Indus are now protected with embankments along the greater part of its course from Kashmor to the delta, and a River Indus Commission has been constituted as an Advisory Board in all matters relating to the river.

These measures have stimulated cultivation; and the Irrigation Revenue Report for Sind for 1900-1901—the latest which I have seen—shows that, in that year, the total area of cultivation was the largest yet reached. There was an increase of 475,000 acres, "as compared with the preceding year, and of nearly 250,000 acres as compared with the hitherto record year of 1897-98." Such figures indicate, of course, a large increase of agricultural wealth. Another result of the policy of recent years has been a very desirable increase of population in an underpeopled country. The census of 1881 gave Sind, exclusive of the Khairpur State, a population of 2,417,057. In the next ten years, it increased to 2,875,100, and the increase of 19 per cent. was due to the extension of cultivation by means of canals. In 1901, the population, which then numbered 3,210,910, showed an increase of nearly 12 per cent. in ten years. The mean density of population is 68 to the square mile; and ranges from 27 to the square mile in the desert tract of Thar and Parkar to 112 and 125 in the Hyderabad and Shikarpur Districts, which have derived the most advantage from the extension of canals. Thirty years ago the corresponding figures for Thar and Parkar and these two districts were 14, 77, and 88.

* Sir H. M. Elliot's "History of India," Vol. I., pp. 511, 512.

* "Annual Irrigation Revenue Report, Sind, 1900-1901," pp. 63-65.

On the Upper Sind frontier the mean density of the population has risen during the same period from 47 to 89 to the square mile.* On the completion of the Jamrao Canal, three years ago, the experiment was tried by Sir Evan James, late Commissioner in Sind, of colonising some of the lands brought within the influence of the canal with cultivators from the congested districts of the Panjab—Baluchis, Marwaris, Cutchis, and others. It was feared that cultivators already in Sind might abandon their old lands on the opening out of new virgin soil; and to obviate the loss that would thus be caused to the zamindars of the deserted lands, a colonisation scheme, on the lines of the Chenab Colonisation Scheme of the Panjab, was adopted; and Sir Evan James drew up the conditions of the new tenures, providing amongst other things against mortgages of the lands of the new occupants. This, to my mind, is a wise provision, whenever the debt is small, as is the case with most agricultural debts. In such cases, the creditor ought to be content with the debtor's personal security. A different practice has brought untold misery on the cultivating classes of the older districts of the Bombay Presidency. Two selected officers, Mr. Robertson and Sirdar Mahomed Yakub, were entrusted with the duty of bringing colonists from the Panjab; and the experiment has already succeeded beyond all anticipations, the area brought under cultivation in three years having amounted to about 600 square miles. This is only one of many good works by which Sir Evan James has won the gratitude of the people of Sind.

Canals in Sind may also be regarded as a powerful civilising agency. At one time, not so very long ago, travelling was not safe near the frontier without the protection of an armed escort. The whole country-side was infested with thieves, who, however, were glad to become honest men and take up land for cultivation, as soon as it was offered them, on the opening of the desert canal from Kashmor, westwards. Indeed, shortly after a portion of it had been opened, an English lady rode a camel from Jacobabad to Quetta without an escort and without harm. In view of such an incident it is satisfactory to read in Mr. Enthoven's able and instructive report on the Bombay census of 1901 that 74 per cent. of the population of the Upper Sind frontier now support themselves by agriculture. The percentage is higher in the Bombay Presidency only in the Ratnagiri district of the Southern Konkan. The average proportion of agriculturists to the whole population is 59 per cent. for the whole Presidency.

* "Census of India, 1901," Vol. IX., Pt. I., p. 16; Vol. IX.—A., Pt. II., p. 2; and Vol. IX.—B., Pt. III., p. 19.

VEGETATION AND SCENERY.

Within the area watered by the canals all vegetation is luxuriant. Where the soil is deep and rich, as it is in most of the alluvial tracts, the cereal crops develop a growth unknown on used-up lands elsewhere. At Jacobabad, bodies of spearmen, riding through a field of "Jowari," the great Indian millet (*Sorghum vulgare*), have been known to screen themselves effectually, horses, spears, and all, in the lofty shelter of the cornstalks. In the forest reserves near the Fuleli at Miani, the "Babul," or gum Arabic tree (*Acacia arabica*), and the "Kandi" (*Prosopis spicigera*), the two commonest forest trees of Sind, attain a height and girth beyond anything seen in Guzerat, the garden of India, or the Deccan, where the Babul is very much at home. In the Collector's garden at Larkana there is a splendid *Ailanthus excelsa*, excelling in size and vigour of stem, branches, and its great pinnate leaves, any of the fine trees in the grove so well known to travellers at one of the villages on the road from Wattar to Mahableshwar. The "Tali," or Blackwood (*Dalbergia latifolia*), also thrives in Upper Sind, but not so luxuriantly as in the neighbourhood of Agra. At Shikarpur, the magnificent avenue of "Sirras" trees (*Albizzia Lebbek*)—an entirely modern growth of British times—gives a most grateful shelter from the hot sun of March or April; nor can I soon forget the plantation of Chinese Tallow-trees (*Sapium sebiferum*) near the little English cemetery at Sehwan, below the massive mud fort on the Indus, which, some say, was built by Alexander, and some, by Shem, the son of Noah—with what authority, in either case, no one can perhaps say. I have grown these shapely trees, which, in general contour and size, are comparable to the birch, on the red soil of Malabar Hill in Bombay and on the sandy soil of the University Garden on the Esplanade, and successfully; but they have never displayed there the rich sunset-tints, purple and crimson and gold, with which they glorify the landscape in the crisp, chilly evenings of the late autumn in Sind. Nor will any Sindhi be slow to pay his tribute to the pervading grace of the endless

self-sown tamarisk thickets of every landscape in Sind of which any stream or pool of water forms a part. In his carefully prepared "List of Trees, Shrubs, &c.," of the Jerruck division, Mr. G. K. Betham includes three species of tamarisk, one of which, the "Asri" (*Tamarix articulata*) is a tree of fair size. In some parts of Sind the tamarisk jungle gives cover to vast numbers of wild pig.

Beyond the reach of the silt-laden waters the dry and hardened ground is almost bare, and in such places the physical contrast is most striking between the landscapes of Sind and the hilly tracts of some other parts of the Bombay Presidency. My recollection of particular plants is not recent, but I have refreshed my memory from a paper I wrote only a few years after I had left Sind, and I then noted that, where there was any vegetation at all, the characteristic plants, in places beyond the influence of the river and the canals, were those of the desert—the "Kirar" or leafless Caper (*Capparis aphylla*)—essentially a lonely plant, but beautiful, with its countless brick-red flowers,—the "Pilu" (*Salvadora persica*) with fleshy leaves, and strings of translucent, rounded, glutinous fruit, shining like pearls—and the *Parkinsonia aculeata*, with clear, yellow, crumpled flowers, freckled with brown, and spiny branchlets, which once suggested to a great Italian painter his idea of "the Crown of Thorns." Then there is an undergrowth of Camel-thorn (*Alhagi Camelorum*), which, near Kandahar and Herat, yields manna "at flowering time, after the spring rains," and is an agreeable food for camels and useful for door-tatties in the hot weather,* and of various plants of the Goosefoot tribe (*Chenopodiaceæ*), one of which, the *Sueda maritima*, yields, according to Mr. Betham, "an impure carbonate of soda," used in soap-making, calico-dyeing and washing," and is also a favourite food of the camel. And there is that curious plant, the "Panirio" (*Withania coagulans*), of the potato tribe, whose juice curdles milk into "panir" or cheese. In these arid tracts, with such strange herbage, the traveller misses the fresh, bright tints which enliven the forests of the Konkan and the Western Ghâts in the early spring of March or in the second spring of the early weeks of June. The prevailing tones are sad, secondary, bluish-greens, and the same faint colours repeat themselves everywhere on uncultivated lands, and are only rarely relieved by the deep, glossy greens of the Salvadora. There is nothing like it in the rest of the Presidency, except in the districts nearest Sind. It is to the Flora of Africa that the indigenous vegetation of Sind is most closely allied.

* Dr. Dietrich Brandis's "Forest Flora of North-West and Central India," p. 145.

FAUNA.

Of the wild animals of Sind, it may also be said that they comprise many distinctive types and species. As observed by Sir Evan James in a lecture delivered before the Dayaram Jethmal College at Karachi, "Sind in on a kind of dividing line between the peninsula of Hindustan, with its tropical forms, and the temperate regions of Baluchistan and Persia." It is a "half-way house," therefore, "where vast numbers of rare birds meet," and in the cold weather is "simply a paradise to the lover of birds;" and, as regards the further investigation of the Department of Mammals, he gives good ground for the remark that there is yet "work to be done in Sind." Every English officer who has served in Sind will endorse these statements, for every English officer is, by the happy opportunities of his daily life and by his instinctive love for every wild thing, a sportsman and a naturalist, whether he has learnt his lore on the rocky hills—the homes of the ibex, the markhor, and the gad, the hyena, the porcupine, the ant-eater, and an occasional leopard or Thibetan bear; or in the forest plantations, the hunting grounds of the Amirs, traversed by the hog-deer, and by numerous wild cats, including the lynx, but no longer by the tiger or the great swamp-deer; or else on the numerous "dhands" or lakes, formed by the overflow of the Indus, and glorious with water-lilies and tens of thousands of bright feathered water-birds. On the great Manchar lake near Sehwan wild swans have been seen, and several kinds of wild geese are common; and elsewhere ample occasion may be found by the naturalist for his favourite pursuits, either in desert places frequented by the "houbara," or Sind bustard, and several species of sandgrouse; or by the pools of the salt Rann of Cutch, where "the wild asses quench their thirst;" or in the stubble fields of Upper Sind, where the black partridge most abounds; or, in reedy marshes swarming with snipe; or on some tamarisk-shaded island of the the Eastern Nara, with its rare wood-peckers, gay in green and scarlet, its dappled king-fishers, and its endless arrays of solemn

pelicans and flamingoes keeping guard along the sandy beach.*

As regards domestic animals, honourable mention must always be made of the grand buffaloes of the pastoral tracts between the Mitrao Canal and the Eastern Nara, the single humped camels, which do most of the carrying work of the country, and are also employed in turning water-wheels for irrigation, the hardy breed of horses and ponies, and the four-horned, large-tailed sheep known as "Dumbas."

During my service in Sind, I had the singular good fortune of being allowed by the Karachi Municipality to lay out on a new plan their garden of 40 acres on the banks of the Lyari, and was able, in association with the Municipal Engineer, Mr. Strachan, to whom Karachi is indebted for many fine public buildings and other works of public usefulness, and Mr. Ffinch, late Director-in-Chief of the Indo-European Telegraph Department, and with the willing help of district officers and Indian gentlemen throughout the province, to form, in the garden, the nucleus of a good collection of wild animals, which, under the skilful care of Mr. Ffinch, in later years, has become, I am told, the best zoological garden in India. I will presently show on the screen a few photographs by Mr. Parsons, late Acting Chief Justice of Bombay, of some of the animals, and also of views in the garden, which, thanks to the completion of Mr. Strachan's Malir water scheme, began to make a good show in a very short time. By that admirable scheme, fresh, pure water was brought from the Malir river, a distance of 14 miles, to the camp and city of Karachi. The Malir is simply a continuous expanse of sand; but, deep down below the surface is a stream of naturally filtered water, which, by means of wells sunk through the sand and a masonry channel leading from them, finds its way by simple gravitation to the Temple Reservoir at Karachi. No pumping is required anywhere.

* Mr. J. L. Jenkins, of the Indian Civil Service, has sent me a most interesting Note on the Fauna of Sind, from which it appears that, in 1881, a tigress and two cubs were still left in Sind. The cubs were drowned in the great flood of that year, and the tigress was shot a few years afterwards by Colonel McRae. Three swamp-deer survived in a forest in the Ubaro district till 1881, when they also were drowned in the same flood. Mr. Jenkins has shot six kinds of sandgrouse in Sind, including the *Pterocles coronatus*, which is not found elsewhere in the Bombay Presidency. According to the late Lieut. Barnes, it is "only a cold weather visitant,"—apparently from Southern Afghanistan.

Railways and Imperial Defence.

But, before we pass from the map still on the screen, I should like to point to the railway lines shown on it, the importance of which, whether for purposes of communication, or the development of trade, or the strengthening of defences, is measured by the obvious importance of the geographical position of Sind, and by the clear necessity for protecting the great port of Karachi and its trade in every possible way. It has been fortunate for Sind that two recent members of the Viceroy's Council, in charge of Indian public works, Sir Charles Pritchard and Sir Arthur Trevor, had already been Commissioners in Sind, and members of the Bombay Government, and were both intimately acquainted with the needs of the province, before they joined the Government of India. As regards railway communications, therefore, Sind has, so far, been most judiciously provided for, Karachi being now in direct communication by rail with Quetta and Peshawar, and, by way of Shadipalli and Dhoro-naro, with the railway system of Rajputana, and, through it, with Bombay, the United Provinces of Agra and Oudh, and Northern Bengal. A chord line on the left bank of the Indus has lately been constructed between Hyderabad and Rohri, because the set of the Indus, to its right, endangered the right-bank line, and frequent breaches of the permanent way seriously interrupted communication between Karachi and the North, and dislocated the export trade. The new line is on high ground, and is fairly safe from inundations. It gives an alternative route from Karachi to Quetta and the north-western frontier, and saves thirty-six miles on the journey from Karachi to the Panjab. It has also the merit of serving the rich tract of country watered by the Jamrao Canal. Of the two railway bridges across the Indus, the one at Kotri was opened in 1900, for the purposes of the chord line to Rohri and the line to Rajputana. The Sukkur bridge, on the original line from Karachi northwards, connects Sukkur with Rohri by way of the island of Bukkur. The span between Bukkur and Rohri is constructed on the cantilever principle, and is 790 feet long. The other three spans are respectively 270, 230, and 90 feet long. A new line to connect Ahmedabad or Viramgam, through Kathiawad, and thence by way of Lakhpat, in Cutch, and Mugalbhim, either with Karachi or Hyderabad, is also projected.

For many ages, the former rulers of Sind were drawn by the conditions of their time and

state to a closer intimacy with the Afghans and Baluchis than with the people of the continent of India, and, therefore, they exercised little or no influence over the political affairs of India.* The great desert of Rajputana was a barrier to communication eastwards. Indeed, in no direction, even within the province itself, was communication easy. In the days of our immediate predecessors, articles of food may have been cheaper than they are now, and the peasantry may have been more truthful, as old men lately living were fond of saying, but there were no good roads, and no proper postal arrangements. I am told that Munshi Awatrai, formerly prime minister of Mir Sobdar Khan, used to say that it took nearly a fortnight for a letter from Hyderabad to reach Khairpur, and that a special messenger had to be employed at a cost of Rs. 60. The construction of roads and especially of railroads has, however, removed many ancient obstacles, and Sind can now realise, as never before, its rightful position. What the fulcrum is to the lever, what the axle to the wheel, the wrist to the hand and the shoulder to the arm, that, with every improvement of communications, is Sind tending to become in relation to the rest of India; and when Karachi, the nearest Indian port to Aden and the Persian Gulf, has grown to its destined greatness and is linked by direct lines of rail with every administrative centre in India, then Sind cannot fail to become the pivot of our whole Indian political system. Its place is now, at all events, within and not outside that system. In the prosperity and progress of India, Sind has now its share; and, on the other hand, any danger to Sind would be a shock to the whole of India, and would vibrate throughout the British Empire. Sind has borne the brunt of many invasions in the past; and, in possible developments of the restless "Middle Eastern Question," such a combination of new political forces might yet be evolved as might again threaten the sanctity of its soil. We could never, of course, allow any such threat to be accomplished, but we ought, by adequate measures of precaution, to make the threat itself impossible. No more pressing question than the effective completion of the defences of Sind against every possible attack, whether by sea or land, could well engage the attention of the Council for National Defence; and, at the present moment, in a time of peace, when the necessary arrangements can be carried out at a comparatively small cost, it is a matter for consideration whether the port of Karachi ought not at once to be made the trooping port for India. On the outbreak of a war involving India, it would certainly be used as a trooping port, and then it might be difficult to make effective arrangements promptly.

I will now, before proceeding to take a brief retrospect of past events in Sind, show some of the photographs of which I have spoken.

Aryan Influence in Sind.

In the times of the great Indian Epics, the Hindus of Sind, though their ascendancy was not always undisputed—for they were constantly harassed by numerous wild races on the left bank of the Indus—were yet clearly recognised as within the Aryan comity of nations. Their ruler, Jayadrath, married Duhsala, a daughter of Dhritrashtra, the blind brother of Pandu, and father of Duryodhana, the leader of the Kauravas, to whom he allied himself in the great war with their cousins, the five Pandavas. Jayadrath brought splendid horses with him from Sind, and the Pandavas also are described as having great cars, drawn by steeds of the *Saindhava* breed "with the speed of the hurricane."* Jayadrath is at first described as "the famous King" of Sind, Sivi and Savira, and other countries, but, after his treacherous attempt to carry off Draupaudi, which was frustrated by the prompt pursuit of the "heroic" Pandavas, he is thenceforth styled "the wicked King." His whole force was crushed, and though his own life was spared, he returned in humiliation to his own country. This is the earliest record we possess of a King of Sind. It is interesting to note that Duhsala was appointed by Duryodhana to rule over the rival tribes of Jats and Mers, who, according to Sir Henry Elliot, "may be considered the oldest occupants of Sind, who, in their names, as well as persons, have survived to our own times." These tribes were, at one time, locally reputed to be descended from Ham, the son of Noah, but that was not till after their conversion to Mohammedanism. Duhsala "exercised the functions of government with great wisdom and moderation."† Duryodhana sent 30,000 Brahmans from all parts of India to her court

* Mill and Wilson's "History of British India," Vol. VII., p. 5.

* Protap Chandra Roy's "The Mahabharata," Vol. II., p. 789.

† Sir H. M. Elliot's "History of India," Vol. I., p. 520.

at Askaland, and "from that time," it is said, "Sind became flourishing and populous, and many cities were founded." Jayadrath and Duhsala reigned together for more than 20 years, and then he was killed at the battle of Thanesar, which extinguished the Bharata dynasty. On the transfer of the empire, however, to the Pandavas, the kingdom of Sind was conferred by them on Sanjwara, the son of Jayadrath and Duhsala, one of whose descendants was the Raja Hál, who may perhaps have given his name to the Hala Mountains and the town of old Hala. So far as Sind is concerned, little or no light is thrown by Hindu literature on the history of the eight centuries which followed the great war of the Kauravas and Pandavas.

From certain indications in the Epic Poems, my friend Mr. Dayaram Gidumal, district judge of Shikarpur, to whom I am indebted for a most valuable Note on the language and ethnology of Sind, is inclined to the view that the Pandavas may have been the Jats of the hilly tracts of the Panjab, who are represented to us at the present day by members of that tribe in the Sikh regiments of His Majesty's Indian army—men of splendid physique and manly bearing, and always true to their salt, who may well have sprung from a race of heroes. There were Jats, also, of the plains, who were apparently represented in ancient Sind by the tribe to which I have just referred.

Some evidence of the extent of Aryan influence must be looked for in the Sindhi language. Dr. Ernest Trumpp describes Sindhi as "a pure Sanskritical language, more free from foreign elements than any other of the North Indian vernaculars." It is "much more closely related to the old Prakrit than the Marathi, Hindi, Panjabi, or Bengali of our days." Its vocabulary contains many Persian and Arabic words, especially words relating to abstract ideas or connected with politics and war, but, at the same time, it seems to have preserved "most important fragments" of "the old venerable mother-tongue," and has "remained steady in the first stage of decomposition after the old Prakrit, whereas all other cognate dialects have sunk some degrees deeper," and has "become an independent language, which, though sharing a common origin with its sister-tongues, is very materially differing from them." * Mr. Dayaram also lays stress on the use of the Sanskrit word "Raj" as still meaning a "village community" in Sind and on the circumstance that there are still Batai customs, regarding the division of grain between the landowner and the cultivator, which remind us at each step of the Aryan village community. "As a landowner," he says, "I have old *Khasras* (records of such divisions), which show how much was given out of the grain, at the Batai, to carpenters and blacksmiths, to crop-watchmen and water watchmen, and others. The Sanskrit word 'Raj,' again is even now applied to the cultivators in a village, though they may be all Mussulmans." Mr. Dayaram notes also that, "in villages, the Sindhi spoken by the Mussulman population does not differ materially from that spoken by the Hindus. Indeed, this is a characteristic of the province. Elsewhere, the Mussulmans generally speak Hindustani, or a corrupt form of it, while in Sind the language of the Mussulman is that very Sindhi which is allied to the Panjabi, and is said by Trumpp to be nearer to Sanskrit than any other Prakrit language."

* Dr. Ernest Trumpp's, "Grammar of the Sindhi Language," Introduction, pp. 1, 2.

Invasion of Alexander the Great.

Some evidence, though not much, as to the condition of the people of Sind in the fourth century B.C., may be found in the narratives of the historians and men of science who accompanied Alexander the Great in B.C. 327, when Sind was no longer a kingdom under one ruler, but was ruled by several independent chiefs. After the capture of Multan, Alexander constructed a new fleet, for the conveyance of his troops down the Indus, at the town of Alexandria, which he built at the junction of the five rivers of the Panjab, probably near the site of Jayadrath's capital, Askaland,—the Uch of later times. At the apex of the delta of the Indus, he founded the city of Patala, which has been identified with Hyderabad, and also with Tatta on the opposite side of the Indus and a little lower down, and there he planted a military settlement. Opportunities were thus given for observation and study. And though Alexander annexed no provinces, and merely transferred territories to the chiefs who had helped him, and though, perhaps, the principal result of his campaigns was to give to the people of the Panjab and Sind their first knowledge of the West, and such impressions of Western enterprise as might be derived from personal experience of the pressure of a foreign invasion, yet it was by the Greek writers in his army, or others who reproduced their narratives,

:hat India east of the Indus was first made known to Europe; and their works are still a source of information to Eastern scholars. After their time we have no clear indication of the events of several centuries, but in the early years of the Christian era we know that the country "was subject to frequent revolutions."* In Sind itself, the great "Sikandar Shah" s not yet forgotten, whose army brought dates with them from a far country, and cast away he stones on their camping grounds. Cannot the very sites of these camps be traced even now by the date groves which have sprung up on the banks of the Indus? So slight are he incidents of a momentous epoch which sometimes linger longest in the popular fancy.

Prevalence of Buddhism. Arab Invasion.

Students of history should be grateful to Mirza Kalichbeg Fredunbeg, Deputy Collector of Naushahro, for translating, for the first time into English, the Persian translation of the entire Arabic manuscript of the "Chachnamah," written by Ali, son of Muhammad Kufi, in A.D. 1216. This is the oldest history of Sind, nd not a romance, as it was once supposed to e, and describes the usurpation of the Kingdom f Rai Sahisi by his Brahman chamberlain, hach, and the subsequent invasion of Sind by ea, from Persia, and its conquest, in A.D. 711, rom Rai Dahir, the son of Chach, by the rabs. Rai Sahisi was the fifth of the Buddhist ings of the Rai dynasty whose names have ome down to us. Their capital city was Alor Upper Sind, and the dynasty was in power om about A.D. 495 to A.D. 632.† The Brahian dynasty of Chach comprised only three igns, that of Chach himself, his brother, and is son Dahir. Perhaps there are some deotees of an intellectual and absorbing game ho will revere the memory of Chach when ey learn that, in all probability, according to high an authority as Sir Henry Elliot, he vented the game of chess and possibly gave s own name to it, though by other authories a much earlier, but also a Hindu, origin s been assigned to the game. It found way to Persia and thence to the West.‡

Mr. Dayaram Gidumal, in his introducon to the Chachnamah, shows that, by the h century A.D., Buddhism had become e dominant religion in Sind. There re Buddha temples, and Buddha monasteries, and, at Sehwan, a large proportion of the inhabitants were Buddha extremists, who refused to fight the Mussulman invaders because it was contrary to their religion to do so. The fort was accordingly surrendered, but a patriotic minority gave battle at Shah Hassan, near the Manchar Lake. Buddhism was not, however, a State religion in India, and the Buddhists and Brahmans lived in amity in Sind. Of the characters whose deeds are celebrated in the Chachnamah, two only, according to Mr. Dayaram, can be regarded as "sturdy and earnest persons," and one of these was the young Arab Conqueror Muhammad bin Kasim, the son-in-law of Hajjaj, the Governor of Irak, who, after storming the sea-port of Debal, which is supposed to have been Manora, near Karachi, overran the lower valley of the Indus up to Multan. His faithful services did not, however, save him from the cruel death to which he was ordered by the Khalifa on the false charge brought against him by the two daughters of King Dahir, in order to be avenged on him for their father's death. It is worthy of note that, in his memorable campaign, neither tillers of the soil nor artisans were injured. He re-employed the Brahman establishments of his Hindu predecessor, and allowed them a percentage on Revenue collections. The Brahman Minister of Dahir became his Prime Minister, and "several Hindu chieftains, whose principalities had been guaranteed," became his allies and counsellors.

Mr. Dayaram cites the Chachnamah in support of the views expressed by Sir William Muir, in his "History of the Khalifate," as to the principles followed by Mussulman rulers in the government of conquered nations. In a remarkable edict issued by Hajjaj, orders were given to Muhammad bin Kasim not to interfere with the people in the exercise of their religion, even if they worshipped stocks and stones. If any one wished to follow his own religion, he could do so on paying the *Jizia*, or poll-tax. This edict was not always obeyed by subordinate officers, but "Muhammad Kasim at least appears to have been true to it."* After his time, however, the Arab rule became oppressive, and little consideration was shown for those who adhered to their ancient religion. The tribunals became, according to Sir Henry Elliot, the means for forcible conversion, penalties were inflicted on Hindus for riding on horseback, and they were forced

Sir H. M. Elliot's "The Arabs in Sind," app. p. 171.
Sir H. M. Elliot's "The Arabs in Sind," app. p. 171.
Sir H. M. Elliot's "The Arabs in Sind," app. p. 175.

* "The Chachnamah," Introduction, p. vi.

to wear beards and dress like Mohammedans. Religious processions and even music were prohibited, and "the primary obligations inseparably connected with the institution of political society were utterly ignored." The Arab dominion was maintained for three centuries, but left but little impress on the language, arts, architecture, and customs of the people. The Arabs built cities with materials taken from the cities of former rulers; but their own cities—Mansura, Mahfuza, and Baiza — have entirely disappeared, while the older sites of Bhambora, Alor, Multan, and Sehwan still remain.*

Spread of Mohammedanism. Turki and Afghan Invasions.

Notwithstanding the exhibition of a tolerant spirit at first, and the fact that, for several generations, the Arab conquest was far from complete, yet it certainly forced many of the best tribes in Sind to emigrate. Many of the Rajput survivors of the war went to the neighbouring Rajput States. Others went further afield, and those who remained proved to be turbulent subjects. Indeed, for a time, the Arab Governors were afraid to live in Sind, and used to send their orders to their subordinate officers from the border territory. However, the fact that the large bulk of the population in time became Mussulman shows that the Mohammedans eventually obtained a firmer hold; and though, by the 9th century A.D., the political control of the distant Khalifas had greatly declined, an Arab Government at Multan, supported by a second Government at Mansura, probably near the modern Hyderabad, ruled Sind till the 10th century, when it was found desirable to strengthen the Arab tenure by additional settlers. But towards the end of that century a period of anarchy ensued, and in A.D. 1026 Sind was subdued by the celebrated Sultan Mahmud, the Turki Chief of Ghazni. His successors maintained only a nominal suzerainty over the tributary chiefs of Sind, the most prominent of whom were the Sumras, a tribe of Pramar Rajputs, who, however, after their conversion to Mohammedanism, claimed descent from some of the Arab settlers. They rose to power about A.D. 1056, and were the real governors of Lower Sind for three centuries. The feeble and distracted rule of the Ghaznavids was displaced by the Afghans of Ghor, under Muhammad Ghori, in A.D. 1186.

* Sir H. M. Elliot's "The Arabs in Sind," app. pp. 84, 88.

Subsequent History.

The subsequent history of Sind, till it conquest by the British, just sixty years ago is full enough of lively interest. Thougl the Province was subject to perpetual raid from the Ghorians and the Khalji an Taghlakid rulers of Delhi, and afterwards t the devastations of the Moghals, still, durin eight centuries, after the rise to power c the Sumras, it is possible to recognis the rule, more or less firmly establishec of seven local dynasties in Sind; first th Sumras (to whom I have just referred), the the Sammas, who were also Rajputs—of th Lunar race—and ancestors of the Sameja and Jarejas of Cutch, and were, like th Sumras, converted to Islam; and then th Arghuns, descendants of Changiz Khan the Tarkhans, who were in power for 3 years only before submitting to Akbar the Daudpotras, who founded Shikarpur; th Kalhoras, descendants of Abbas, the uncle the Prophet, under whose rule an Englis factory was established by the East Indi Company at Tatta in 1758, but was eventuall withdrawn in 1775; and, last of all, our immediate predecessors, the Baluchi Talpurs But these local dynasties did not always ru continuously, nor always with exclusiv authority, for, after the conquest of Sind b Akbar, it was incorporated in the Subah Multan, and when Nadir Shah took possessio of the country west of the Indus, the Kalhor dynasty became tributary, first, to the Crown Persia, and then, on the death of Nadir Sha in 1748, to Ahmed Shah, of Kandahar. A attempt to merely summarise the events of th period would be a thankless task, and detailed narrative would be beyond the scope this paper. I will refer to a few incidents only peculiar interest; first noting that, during th period, several new races settled in Sin The Arabs were followed by the Moghuls an Pathans, the Kalhoras and Baluchis, and som of these intermarried with the earlier inhab tants. The Arab, Moghal, and Pathan strair are still visible in tribes speaking Sindhi bu preserving the names of the tribes to whic their ancestors belonged, and to some exter their customs. The aboriginal races hav mostly become Mohammedans, and at th present day about 77 per cent. of the inhabi ants of Sind are Mohammedans. The unmixe Aryan blood is to be found in a few Brahmar Kshatria, and Vaishia families, and in thos who have emigrated from the Panjab to Sind and the greater part of the Hindus now i

ind follow the religion of Guru Nanak of the Panjab. The inland trade is almost entirely n their hands, and they are also the bankers of the agricultural classes. A small minority of them were employed as ministers and administrative officers under the Mussulman ulers, and, until his death, a few years ago, the ate Amir of Khairpur, Mir Ali Murad, had Hindu Ministers in his service. The old Hindu officials, known from their occupation as "Amils," who are followers of Guru Nanak, and probably came with the Kalhoras from the Panjab, were retained by the British Government, and the number of Hindus in our public offices has always exceeded that of Mohammedans. An impulse has, however, been given o the education of Mohammedans by the oundation of the Madressa at Karachi and he gift of £5,000 by the present Amir of Khairpur for scholarships; and Mohammedans are now taking a more prominent part in the work of administration. The present Minister of the Khairpur State is Vazir Kadirdad Khan, who was for many years in the British service n Sind; and Sirdar Mahomed Yakub, to whom have already referred, is still the colonisation officer for the Jamrao scheme.

The Buried City of Brahmanabad.

The first of the incidents of special interest f which I wish to speak before closing this paper is the sudden destruction of the ast and ancient city of Brahmanabad, probably by a sand storm, about A.D. 1020. My object is to invite public attention o certain discoveries made by Mr. Bellasis and Mr. Richardson many years ago,* ecause their researches were of the ighest interest, and, so far as I know, no urther effort has been made up to the resent time to investigate the ruins. With his same object, I read a paper on "The uried City of Brahmanabad,"† before the assoon Institute in Bombay, in 1885, after nspecting the ruins myself in the preceding ear. Again, I can enter here into no details. It will be enough perhaps to say that Brahmanabad was the seat, or one of the seats, of more than one dynasty of Hindu kings. The rst of whom we have any authentic account as the good king Sahiras, in whose time here was no disaffected person in the kingdom. ut the best known was Chach, the Brahman usurper, of whom I have already spoken. It was a city of merchants and traders, large and populous, surrounded by battlements, four miles in circumference, with 1,400 bastions. The streets of the city can still be seen as open spaces, but the buildings have all, except one tower,—left standing, as the historian tells us, "as an example,"—are shapeless mounds of sand and brick. There can be no doubt, from what has already been discovered, that these mounds cover not only the skeletons of men and animals who were suddenly overwhelmed by the sand, but quantities of old coins, ornaments of stained glass and ivory, tortoise-shell and precious metals, cornelians, onyx, agates and other precious stones, glazed pottery, earthenware and china, cutlery and vessels for household use, and old baked clay balls, evidently meant as ammunition for catapults, which, if not known before the time of Muhammad bin Kasim, were at all events a part of his equipment. He landed five catapults at Debal, each of which took 500 men to work it. Near Brahmanabad I saw a large number of these clay balls piled in heaps, just as round shot are now piled, in a field, called the arsenal, which is said to have been an old battle field. Mr. Bellasis has minutely described everything that he found, including a set of chessmen in black and white ivory, probably the oldest known set. At the time when I visited Brahmanabad, no excavations were permitted, evidently for good cause. But there seems to be no good reason why these ruins should not now be thoroughly explored under competent superintendence.

The popular belief is that the city was destroyed for the sins of the wicked king Dalurai, who was buried beneath its ruins. In a popular proverb and legend about Bibi Dali, the Cassandra of her time, who foretold the doom of Brahmanabad, we are told how she was asked to save the innocent when the city was destroyed, and adopted a remarkable expedient for testing the righteousness of the people. She placed a live fowl in the hands of her maidservant and told her to go through the streets of the city and to pluck the feathers off the bird with violence as she went, and to bring back word if any man or woman tried to stop the cruelty. But not a voice was raised, not a hand put forth; and so the city fell.

Birth of Akbar at Umarkot. First Employment of Sepoy Troops in India.

The next incident, which is sufficiently

* See A. W. Hughes's "Gazetteer of the Province of nd," pp. 126-145.
† See "The Madras Christian College Magazine," Vol. I., p. 184.

memorable, is the birth of the Emperor Akbar in the town of Umarkot in Eastern Sind, in October, 1542, while his father, the Emperor Humayun, who was accompanied by the Empress, rested there, after he fled, for the first time, from Delhi, and before he made his second unsuccessful attempt to conquer Sind. The province was, however, conquered by Akbar himself; and the third incident I have to mention is that, when he laid siege to Sehwan in A.D. 1591, the Chief of Sind employed Portuguese soldiers to defend it, and also dressed 200 of his own men as Europeans. The incident may seem trivial, but it is given by Mountstuart Elphinstone as the first instance of the employment of Sepoy troops in India.* It was during the reign of the just and sagacious Akbar, the greatest and noblest of the Moghal Emperors, that the people of Sind enjoyed a period of good government such as had not always been their lot, and there can be no reason to doubt that it was the influence of two Sindhis—who were Sindhis by extraction if not by birth—Abul Fazl, the Minister, and his brother, Faizi, the Poet Laureate—which largely moulded the character and public measures of Akbar. They were men who by temperament were eminently tolerant; and it is permissible to suppose that their views of life and conduct were imbued with the spirit and remarkable teaching—so nearly akin to the Vedantism of the Hindus†—of the Sufic poets of Sind, who count among their disciples to this day, not only Mussulmans, but many Hindus also. Mr. Dayaram, from whose Note I have already quoted so freely, observes how strange it is that, while some Sindhis should, in former times, have given all Hindus a reputation for robbery and violence, and others, as in Kathiawar, up to our own time, have never brought credit to their country, it should have been reserved for the small town of Sehwan, at all events, to have sent forth "a family from which sprang the two men whom history is not likely to forget, so long as it does not forget Akbar."

I should have liked to say something about the literature of Sind,—its romantic ballads and religious poetry,—and about its arts and manufactures,—its blue-glazed pottery which is used with such beautiful effect in the decoration of many mosques and tombs, and its carpets, silks, cottons, and lacquered ornaments; but time is against us.

* Elphinstone's "History of India," p. 521.

† L. W. Lalwani's "Life, Religion and Poetry of Shah Latif," p. 24.

BRITISH RULE.

The short time that is left will bare suffice for the few remarks which, as in publ duty bound, I wish to make about our ow rule in Sind; and, for this reason too, I pa over the events which led to the rupture of o political relations with the Talpurs and th overthrow of their army at Miani, on the 17 February, and at Dabo, on the 24th Marc 1843; nor will I attempt to argue any ethic questions raised by our conquest of Sind, as which the opinions of critics have been divide Lord Ellenborough's policy was subjected the severest criticism at the time, and le with other causes, to his recall by the Court Directors, in 1844, but he himself was qui satisfied as to its justice and expediency. S Charles Napier's own verdict, before the co quest, was that we had no right to seize Sind,*- and that opinion he maintained, if we are accept as an historical fact his terse despatc to the Governor-General, as commemorate in *Punch*, in which he summed up in th the single word—"Peccavi"—the result his victory at Miani. Sir Frederic Gol smid evidently held that the conquest Sind was forced upon us, as Sir Charl Napier was obliged to call the Amirs account for the infraction of treaties, not for open hostility, at a time when th troubles in Afghanistan had greatly increase the difficulties of our political officers in Sind Sir William Hunter, on the other han considered that an honest excuse cou scarcely be found for the annexation, th only fault of the Amirs having bee their determination not to surrender the independence.‡ In an article in th *Contemporary Review*, for November, 187 Mr. Gladstone cited the conquest of Sin by Napier, under the auspices of Lo Ellenborough, as a notable example of th insufficiency of the restraining force of o own Central Government over distant a ministrators. "That conquest," he wrot "was disapproved of, I believe, unanimousl by the Cabinet of Sir Robert Peel, of whi I can speak as I had just entered it the time. But the Ministry was powerles inasmuch as the mischief of retaining was le than the mischief of abandoning it; and remains an accomplished fact." And as suc it was, in a few years, generally accepte

* Encyc. Britt., Vol. viii., pp. 146, 147; article by I George Smith.

† Encyc. Britt., Vol. xxii., p. 92.

‡ Encyc. Britt., Vol. xii., p. 808.

though the last few years of Napier's Civil administration in Sind were ruffled by constant attacks in England on his policy. On his return from India, in 1847, he received a most cordial ovation. In Sind itself, he has long been a popular hero. When at Miani, 19 years ago, I was shown by an old shepherd the precise track through the fields along which Napier marched his little army from Hala to the Fuleli, after the fierce and unprovoked attack of the Baluch troops on Outram at the British Residency near Hyderabad. He described the positions of our regiments, and also, with much dramatic fervour, the impetuous energy of the General as he led them on—

"Impiger, iracundus, inexorabilis, acer!" — *

I saw too the little doorway in the long mud wall that flanks the battle ground, where a young English officer,—a mere boy,—fell fighting for his distant Queen; as many hundreds of young English boys have since fallen, on many fields, in many lands. But the one circumstance that impressed my guide the most was, that he himself and others were paid, on the nail, the full price they asked, for every goat and sheep and fowl supplied to the British troops.

The battle of Miani, which has been described as "perhaps the most brilliant feat of arms in English history," was the first action of any importance in which percussion caps were used instead of the old flint-lock.†

No better ruler than Sir Charles Napier could have been found for the newly-conquered territory. He organised a regular civil administration throughout the province, put down every form of oppression that had been practised upon the people by the soldiery under the military despotism of the Talpurs, and subdued the robber tribes in the hills to the North, who had become utterly lawless during the period of license following the Afghan war. As an administrator, says Mr. Morse Stephens, "he was never fatigued and never afraid of responsibility."‡ In the settlement of the frontier most effective work was, in later years, done by another popular soldier, General John Jacob, the founder of Jacobabad, where also he died. To this day the people strew flowers, red and white periwinkles, roses and marigolds, on the huge slab which covers his grave, in respectful memory of the man with the iron will who gave the people peace and saved them from falling into arrear with their taxes.

The "wise, firm, kindly, administration," as Sir Frederic Goldsmid has described it, which was inaugurated by Sir Charles Napier, has been continued down to the present day by a succession of able and sympathetic Commissioners in Sind, of whom the most distinguished was the late Sir Bartle Frere, and by a body of capable and experienced district officers associated with them, who were chosen largely, during the earlier years of our rule, from the Indian Army and the Uncovenanted Civil Service. The names of many of these officers are to this day household words in Sind. Sir Bartle Frere was appointed Commissioner in 1850, and strenuously developed the province, where his memory will always be cherished in connection with many matters of permanent importance—in relation especially to the position of the deposed Amirs, for whom pensions were provided, and the rights of the old privileged landholders, which were defined and safe-guarded, the improvement of the harbour of Karachi, which, since his time, has been still further improved, the institution of municipalities, the extension of education, the due and regular administration of justice, and the vigorous promotion of public works. His administration was so successful that, on the outbreak of the Mutiny in 1857, he was free from all anxiety for the internal peace of the province and sent his only European regiment to Multan, "thus securing that strong fortress against rebels," and a further detachment "to help Sir John Lawrence in the Panjab." The 178 British soldiers who were left in Sind proved sufficient, as Sir Thomas Seccombe has placed on record, "to extinguish such insignificant outbreaks as occurred," and Sir Bartle Frere received the thanks of both Houses of Parliament.* Thus early in his career he showed himself the far-seeing and fearless statesman, who never distrusted the future, so long as the present found congenial work for him, wherever he might be, in making firm the foundations or strengthening the supports of British rule.

I will now show the remaining photographs on my list, including views of some of the tombs of the Kalhora princes, of some modern buildings, and also of the monument at Miani,

* If the old shepherd had been a countryman of Napier's he would have appreciated the rendering, in "Waverley," of Horace's description of his hero's prototype—

"A fiery etter-cap, a fractious chiel,
As het as ginger, and as stieve as steel."

† A. F. Baillie s "Kurrachee, Past, Present, and Future." p. 9.

‡ Encyc. Britt., Vol. xvii., p. 177.

* Encyc. Britt., Vol. xxviii., p. 519.

erected in memory of the officers and men who fell there.

There can be no question that Sind has prospered in the last sixty years. I have already spoken of improved communications by rail and road and of the extension of canals and of successful colonisation. But in every department of the Administration there has been beneficial progress. Sind is "about the most contented and prosperous part of the Bombay Presidency" was the opinion lately expressed to me by an officer of wide Indian experience. "There is more land," he said, "than there are people to cultivate it. The settlements are more flexible, allowances are made for fallows, assessments generally depend on the water supply, and remissions are given freely when, owing to accidents or changes in the set of the river, the supply may fail." As regards the irrigational settlements of land revenue, which depend rather on the supply of water to the landholder than on the quality of the soil, another officer, who is intimately acquainted with our Indian landrevenue systems, saysthat they have proved most suitable and beneficial to the country; andyet another officer, of wide experience, says, in reference to recent developments, "In Karachi a splendid Sind Arts College has been built, and opposite to it a grand pile of undergraduates' 'Rooms,' also a very fine Mohammedan High School, and a smaller one at Larkana, the James Wharves have doubled the accommodation for ships, and a small graving dock has been added. A Lady Dufferin Hospital for Women, dispensaries, a grand new market, and extensive import and export wharves have been created or extended. The increase of population and wealth has been very great." The sea-port of Karachi, which was acquired by us in 1839, has been described as, then, "a miserable little harbour," with a populatien of 10,000. The population now amounts to more than 136,000. The sea-borne foreign and coasting trade concentrated at Karachi is now valued at £10,000,000 sterling a year. The external trade of Sind with Afghanistan, Baluchistan, and Seistan is worth £580,000 a year; and the general education of the people is steadily advancing. The Bombay Administration Report for 1900-01 speaks of "much progress in primary schools" in Sind.

Results such as these are about as good a justification of our Rule as the most sanguine could ever have desired. They have been produced by no exceptional treatment by the Indian Government, no artificial or lavish development, as of a new and favoured estate —for that has not been the position of Sind at all,—but by ordinary prosaic methods, by the maintenance of order, the protection of life and property, the regular administration of justice by our judges and magistrates, the considerate working of a well considered revenue system, the advancement of learning, the relief of sickness and suffering, and the prosecution of necessary public works, and by such a steady, cheerful, and hopeful application, on the part of all public officers, European and Indian, to the work in hand as has readily and naturally conduced to the end in view,— the welfare of the people. And having secured that end, public officers of all grades are well satisfied; and the people, for their part, are well pleased also to live under the sway of the "alien race" "from out the sunset,"—who are yet an Aryan race,—in the enjoyment of a fuller measure of personal liberties than was ever possessed by their forefathers, and in the prospect of still further progress, which they are daily becoming better fitted for, and more eager to work for, in association with ourselves.

DISCUSSION.

The CHAIRMAN, on behalf of the meeting, congratulated Mr. Birdwood on the very interesting paper he had read, and on the beautiful views he had thrown upon the screen. The chief value of the paper lay in the wide range of interest it must have excited in the past history, the present condition, and the future prospects of administration in Sind. There was scarcely a topic—whether on history, scenery, or geography—which he had not touched upon, and he had throughout shown that sympathy and that hopefulness which were known to be part of his character, and which were the cause of his success in public administration. There were present General Sir John Forbes, who fought at Miani, and Sir Henry Green, who acted as one of the earliest Chief Commissioners in Sind, as well as others who had borne the heat and burden of the day in Sind, for certainly it was one of the hottest places in India. To him, no part of India was a land of regrets, but one of noble work and high ambitions, and it might be added that, of all the provinces of India, Sind was a land of opportunity, and, he thought, of opportunity turned to good account. Only fifty years ago, there were a few fortified cities, a frontier which was not marked out, and which would not have been of any value if it had been marked out, because of the marauding bands which were constantly crossing it, a scanty population, and a noble river running to waste. That was just after the conquest. He would not enter into the

estion of whether the agents of Providence o conquered and brought Sind under civilised ministration were acting rightly or wrongly; iers would judge of that, but he must regard as an act of beneficent Providence that Sind ssed from the rule which it was formerly under. It d peace, but it was the peace of solitude, the peace iich Tacitus described in ancient days: They call it ace, but it consists in the solitude of the desert. it of most unpromising elements, the British vernment had evolved the present picture of order, ppiness, and contentment, which had been de- ibed in the paper. There were two things in Sind iich anyone would naturally fix his attention , and one of them was the frontier. The ontier, even in his time, was marked by sts, and although those posts were no longer cupied by Jacob's horsemen, they showed what s a very recent state of affairs, which one realised re when one found the cultivators on the frontier, ned and booted, ready to scamper off into the hills, case robbers came down. The river was at hand, d that had been turned, not only into a means getting revenue and growing crops, but of cifying the border. One of the first steps taken the British rulers was to invite tribesmen to me down and take the water of the river—some- nes freely, sometimes at low rates—and try what a e of cultivation was. They soon filled their pockets peaceful means, and the settlement of the border longer required armed block-houses or patrols. nother great agency of civilisation was the dispen- ries. Medical relief was given, and the enemies peace from over the border found out to their eat surprise that they had only to come in d be treated for illness or wounds, which latter ere often the consequence of their own filibustering peditions. By such means those people were rned into honest cultivators and British subjects. ie later system of planting colonies in the desert, w watered by canals, lower down the country was e of the most interesting experiments which d ever been tried. That was merely a modern velopment of the earlier methods which he d described. The whole of the Sind administra- n teemed with instances of successful and manising experiments, and afforded a most in- esting study on the contrast between the modern itish methods, and those which had been supplanted. ndoubtedly the railways were of inestimable value the people whom the Government had taught to ow crops, but he could not help regretting—and it s a regret which would be shared by Sir George rdwood, because he was always aggrieved at the ssing away of the old—that the good old navigation the Indus had passed, which had provided such lightful trips. Nothing could be more enjoyable an going up the Indus and reading the account of w it was in the classic times, and the falling in of e banks with the sound of thunder, described accurately by Quintus Curtius in his history, written A.D. 40. Mr. Birdwood had shown a photograph of the Government gardens in Sind. He (Sir W. Lee-Warner) took to himself some credit for saving them to the people. It was once his fate to be associated with some gentlemen appointed by the Government of India, who were called finance commissioners. Their duty was to cut down, which they often did without much scruple, any "redundant" expenditure they could find in any part of India. One day he found one of those colleagues drawing his pen through the following item in the public accounts of India: "Mrs. Gordon's Establishment, Karachi." Nobody could explain what it was, and it was at once assumed that it obviously was not needed, and the pen was drawn through it. He (the Chairman) was, however, able, from his knowledge of Sind, to point out that the Bengali printers who prepared the accounts of the Government of India had con- verted "Mir's Gardens Establishment" into "Mrs. Gordon's Establishment." Those gardens had been founded for the entertainment of the Amirs of Sind, and he was thus able to save them to the people. He would not, however, at this hour trespass upon their attention, as he saw in the room many old Sind officers, who would doubtless like to tell the Society their own experiences.

Sir RAYMOND WEST, K.C.I.E., said that his acquaintance with Sind related to a time so far back, even before that of Sir W. Lee-Warner, that he could not add any information about that province which would be of any value. One might as well look back to the history of the expedition of Alexander for information about Sind as to look for it to officers who worked there a quarter of a century ago. He would only make one observa- tion upon the admirable and delightful paper, and the remarks by the able Chairman, viz., the intense interest which the province excited in every one who worked there. He was twice on duty in Sind, and from the first officer he met there, to the day he left, nothing surprised him more than the absorbing interest all felt in their province. At first it seemed a somewhat parochial and vestry-like interest. Their province was to them all India— the whole world. But on gaining more information and further considering the matter, he concluded that the parochial interest was, in a large measure, the secret of their great success there. Nature and Providence often performed their experiments on a small scale when the result was intended to benefit all mankind and the whole universe, and such experiments had been found in ancient history to be performed for us already in such countries as Greece and Judea. In modern times a great experi- ment had been carried on under the direction of Providence in such a province as Sind. There states- men and rulers of all parts of the British Empire of the future might gain lessons of infinite value. And the greatest of all lessons which they might learn was that of entire and complete devotion to the work

which was set them to do, and great and intense love of the people, and the country amongst whom they worked. That was the main lesson which Sind had for us, and he trusted the paper would have the effect of stirring up a new and more intense interest amongst those who did not know it. Among those who had served in Sind the flame of affection had never, so far as he was aware, died out.

Mr. ERNEST BENEDICT, M.Inst.C.E., said he was requested by the late Sir William Andrew, the chairman of the Sind, Punjab, and Delhi Railway Company, to give his views on the harbour of Karachi. The harbour was practically a land-locked one. The mail steamers could be brought close to the shore by making wharves, and so deliver their cargo direct into sheds, wagons, or carts, and the passengers or troops could walk across a gangway from the transport into the railway carriages. There was no other port in India where that could be done. In Bombay, the mail steamers could not go up to the wharves except by waiting for high water, and thus suffering delay, but at Karachi they could go at any time. Karachi was, by geographical position, the port of India, but as long as it was under the Bombay Government it would never be properly developed. It was the mouth of the Punjab, and when that mouth was throttled the whole range of the frontier was in danger. It was natural that Bombay should look to itself first, and to Karachi next, and that there shonld be a certain amount of jealousy about Karachi, but no doubt Karachi was, and would continue to be, a rising port. Anyhow there was room for both, and Bombay would never lose its commercial supremacy; but for Government purposes Karachi was the port of India. It would be seen from the Postal Guide, that letters took two days more to go to Karachi than to Bombay, and yet the former was 200 miles nearer to England. The P. and O. had never run a steamer for the mails from Aden to Karachi. If such an arrangement were made in peace time, the whole thing would be ready for war time. He believed that at one time, Karachi was intended as a port for troops, and that there should be rest camps as far as Lahore. They were tried, and found to be too expensive; but in arriving at the expense, it was not noted how railway travelling was saved, a very serious matter in the case of soldiers just arriving in India. By taking them to Karachi, two days' railway travelling would be saved, besides a considerable amount in fares. In view of what was now going on, Karachi should be so developed as to be capable of being a military port for the whole of India. To do that, all that was necessary was a little bit of line in the centre of India, to make a direct route from Karachi to Calcutta, which should be as short as the one from Bombay to Calcutta. There was a magnificent system of railways right along the frontier, from Karachi to Peshawur.

The proceedings closed with a cordial vote of thanl to Mr. Birdwood, for his admirable paper.

Mr. JOHN POLLEN, LL.D., I.C.S., writes:—I a sorry that another engagement compelled me to lea the meeting of April 23rd before the discussion, as wished to bear witness to the devoted service M Birdwood rendered in connection with the garde and zoological collection at Karachi. I noticed th in his paper Mr. Birdwood, with characterist modesty, gave all the credit to others, but I a persuaded that they would be the first to join wit me in giving honour where honour is due. It w Mr. Birdwood who made the gardens the succe they were. Wherever he served—and he served i many parts—he used to make gardens flourish, an he stimulated others to follow his example. I al desired to support Mr. Birdwood in his views wi regard to the necessity for rendering the Soutl Western lateral defences of Sind secure. "Scientif Frontiers" are no doubt at a discount just now, b there is a weakness on our South-Western border Sind which those who know Sind deplore, and whi certainly calls for the attention of the Committee National Defence.

MEETINGS FOR THE ENSUING WEE

TUESDAY, JUNE 2...Royal Institution, Albemarle-street, W 5 p.m. Prof. E. J. Garwood, "The Work of I as a Geological Agent." (Lecture II.)
Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.r Prof. Lionel S. Beale, "The Living God of Livi Nature."

WEDNESDAY, JUNE 3...Royal Archæological Institute, 2 Hanover-square, W., 4 p.m. 1. Mr. J. H. Roun (*a*) "The King's Pantler"; (*b*) "The Origin Baldock." 2. Professor T. McKenny Hugh "Buried Cities, with reference to Herculaneum."
British Archæological Association, 32, Sackvill street, W., 8 p.m.
Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, JUNE 4...Linnean, Burlington-house, W., 3 p.r 1. Miss Alice L. Embleton, "The Anatomy ar Development of Comys infelix." 2. Messrs. \ and G. S. West, "Scottish Freshwater Rankton
Chemical, Burlington-house, W., 8 p.m. Papers l 1. Messrs. G. D. Lander and F. T. Jewso 2. Mr. T. M. Lowry; 3. Mr. F. S. Kipping; 4. M H. D. Dakin.
Junior Art Workers' Guild, Clifford's-inn-ha Fleet-street, E.C., 8 p.m.
Royal Institution, Albemarle-street, W., 5 p.r Professor J. A. Fleming, "Electrical Resonan and Wireless Telegraphy." (Lecture II.)

FRIDAY, JUNE 5...Royal Institution, Albemarle-street, W 8 p.m. Weekly Meeting, 9 p.m. Prof. H. I Turner, "The New Star in Gemini."
Art Workers' Guild, Clifford's-inn Hall, Flee street, E.C., 8 p.m. Paper on "English Lan scape in Water Colour up to 1850."
Geologists' Assoc., University College, W.C., 8 p.n
Philological, University College, W.C., 8 p.m.
Quekett Microscopical Club, 20, Hanover-squar W.C., 8 p.m.

SATURDAY, JUNE 6...Royal Institution, Albemarle-stree W., 3 p.m. Prof. Silvanus P. Thompson, "Th 'De Magnete' and its Author." (Lecture II.)

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FRIDAY, JUNE 5, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

The Society's Conversazione will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, June 30th, from 9 to 12 p.m.

The programme of arrangements will be announced later.

Each member is entitled to a card for himself (which will not be transferable), and a card for a lady. These cards will be forwarded in due course. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the date of the Conversazione. On that day the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Tickets will also be supplied to non-members on presentation of a letter of introduction from a member.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

PRIZE FOR A DUST-ARRESTING RESPIRATOR.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Prize of a Gold Medal, or Twenty Pounds, for the best Dust-Arresting Respirator for use in dusty processes, and in dangerous trades.

The Council are well aware that for many years past the necessity for such an apparatus has been recognised. As far back as 1822 the Society awarded its Gold Medal to Mr. J. H. Abraham, of Sheffield, for a Magnetic Guard to protect persons employed in dry grinding. The apparatus described in the Society's "Transactions" (Vol. 40, 1822, page 135) includes a Respirator to cover the mouth and nose. This Respirator was fitted with magnets, for the purpose of arresting the fine particles of steel thrown off in the process of pointing needles, and in other processes of dry grinding. Although the invention was greatly appreciated at the time, it appears never to have come into practical use, the main objection to it having been, it is believed, raised by the workpeople themselves, who feared that the lessened risk attached to their employment would lower their wages. Similar considerations have, it is believed, stood in the way of the introduction of various appliances intended to limit the risks associated with all trades in which the workpeople breathe a dusty atmosphere. The Council, however, think that such considerations are likely to have less weight at the present time, and they hope that the offer of a prize may draw the attention of inventors to the matter, so that it may result in the production of some suitable piece of apparatus, despite the difficulties with which the solution of the problem is surrounded.

The apparatus will be required to fulfil the following conditions:

(1.) It must be light and simple in construction.

(2.) It should be inexpensive, so as to admit of frequent renewal of the filtering medium or of the Respirator as a whole; or alternatively it should be of such construction that it can be readily cleaned.

(3.) It should allow no air to enter by the nostrils or mouth except through the filtering medium.

(4.) It should not permit expired air to be rebreathed.

(5.) The filtering medium, though it should be effective in arresting dust particles, should not offer such resistance as to impede respiration when worn for some hours under the actual conditions of work.

(6.) It is desirable that it should be as little unsightly as possible.

It should be noted that the prize is offered for a Respirator intended merely to arrest dust, and not for a chemical Respirator designed to arrest poisonous fumes. The applications of

such chemical Respirators are more limited, and there are special requirements connected with them. The Council have, therefore, preferred to limit the range of their present offer to the simpler and more important cases of dust, either dust of all kinds or of some special character, *e.g.*, iron or steel.

Inventors intending to compete should send in specimens of their inventions not later than 31st December, 1903, to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C. Such specimens must be accompanied by full descriptions, and in cases in which the apparatus has been put into actual use, the experience of such use should be given.

Competitors intending to patent their inventions should be careful to obtain protection, as the Council of the Society cannot undertake any responsibility as regards the secrecy of the whole, or of any part, of an invention submitted to them.

The Prize will be awarded on the report of judges appointed by the Council.

The Competition is not limited to British subjects.

The Council reserve to themselves the right of withholding the Prize, of extending the time for sending in, or of awarding a smaller Prize or smaller Prizes.

Proceedings of the Society.

INDIAN SECTION.

Thursday afternoon, May 14, 1903; The Right Hon. Lord George Hamilton, G.C.S.I., M.P., in the chair.

The Chairman stated that as he would be compelled to leave before the conclusion of the meeting, he wished before the paper was read to express his pleasure at being able to be present on the occasion. Sir Charles Lyall was well known to all Anglo-Indians; he had behind him a most distinguished administrative career, and the works which had emanated from him had earned for him a high literary reputation. He had also been associated with scholastic attainments which had been universally recognised. He had, in addition, an exceptional experience of Assam, for he was on two, or even three, separate occasions connected with the administration of that most interesting part of India. The paper was an admirable one, and would interest the audience greatly. There was no man better qualified in the Indian service to deal with the particular problems with which the paper dealt than the author. Assam was a corner of the Indian empire situated in the North-East, and on the map corresponded rather to that portion of the great North-West plain which terminated in the mountains by and beyond Peshawar. But whereas the North-West valley had been the scene of almost innumerable invasions and great historical conflicts, Assam, on the contrary, had never been the scene of any great historical incidents which had had a far-reaching effect. But it was a most interesting locality, because there was hardly any part of India where there was a greater mixture or graduation of race than was found there. Upon that part of the subject the author spoke with exceptional authority, because he was well-known to be a distinguished philologist and ethnologist. Assam had the peculiar feature that it was a province which every Governor-General and every Secretary of State viewed with special approbation, because it was a great industrial asset to our credit. And if we could in the course of time contrive to develop its material prosperity and industrial capacity, it might help to solve some of the problems which were continuing to arise in the over-congested districts of other parts of India. He was sure the audience would accept his expressions of regret that he was unable to be present until the termination of the proceedings. The only reason that he was compelled to absent himself was due to a pressing public engagement, which it was impossible either to postpone or forego.

The paper read was—

THE PROVINCE OF ASSAM.

By Sir Charles James Lyall, K.C.S.I., C.I.E., LL.D.

In endeavouring to give such an account of an Indian province as can be compressed into a paper to be read in less than an hour, it is evidently necessary to make a selection of the topics to be treated. The subject is vast and its different branches can be handled only in the slightest manner. I propose, therefore, to attempt a description, firstly, of the physical aspects of the province of Assam; secondly, of the people who inhabit it, with a slight sketch of their history; thirdly, of British administration, and its problems in the present and future.

Area and Boundaries.

Until the annexation of Upper Burma in 1885, Assam was the frontier province of the Indian Empire on the north-east. It is still a frontier province so far as the valley of the Brahmaputra is concerned, but elsewhere has Burma beyond it. To its north lie Bhutan and

Tibet, but the latter country, except in one short length where a province called Towang marches directly with British territory, is separated from the Assam Valley by a belt of mountains inhabited by barbarous and independent tribes, who effectually bar all intercourse. The province is estimated to contain, including the State of Manipur, 56,243 square miles, of which one half is plain, and the other hilly and mountainous country. The total area is about the same as that of England and Wales. The plains part consists of two great valleys, that of the Brahmaputra, called Assam proper, on the north, 24,283 square miles, and that of the Surma, consisting of Sylhet and Cachar, on the south, 7,506 square miles. Between these is a chain of mountains called the Assam range. North of the Brahmaputra or Assam Valley is the mighty barrier of the Himalaya, and to the east is the immense complex of mountains separating India from China, which joins to the Himalaya the ranges, generally south to north in direction, which form the Yoma, or "backbone" chains of Burma. These chains, on approaching the Himalaya, spread out in a bewildering fan-like labyrinth of hills. In the Surma valley they form the southern boundary of the plain, and at the eastern end of that valley close it in, dividing Cachar from Manipur, and join the Assam Range, which then takes a north-east direction and merges eventually in the Patkoi, which east of Sadiya joins the Himalaya.

The Brahmaputra Valley.

The northern valley, that of the Brahmaputra or Assam proper, is a great alluvial plain, about 450 miles in length, with an average breadth of about 50 miles, lying almost east and west in its lower portion, but in its upper half trending somewhat to the north-east. To the north is the main chain of the Himalaya, the lower ranges of which, clad in dense forest, rise abruptly from the plain. To the south is the great elevated plateau, or succession of plateaus, called the Assam range, much broken at its eastern and western extremities and along its northern face, but in its central portion, from the eastern border of the Garo hills to the watershed of the Dhansiri, a region of tablelands and rolling uplands. The various portions of this range are called by the names of the tribes who inhabit them—the Garo, the Khassi, the Jaintia, the North Cachar and the Naga Hills. At several points on the southern side of the valley the hills of the Assam Range abut on the river, and at Goalpara, Gauhati, and Tezpur, it has spurs belonging to it on the north as well as the south bank. The broadest part of the valley is where the river divides the districts of Sibsagar and Lakhimpur, below which the isolated block of the Mikir Hills on the south, and the projecting group of the Dafla Hills to the north, suddenly contract it. Forty miles lower down it widens out, but at the lower end of the Nowgong district it is again encroached on by the Khassi Hills, among the spurs of which the river makes its way in front of the station of Gauhati, and it is almost completely shut in just to the west of that town, below the temple-crowned hill of Nilachal or Kamakhya, where the stream is only some 800 yards broad. Beyond this point the hills recede again, and the mountains do not approach the Brahmaputra till the station of Goalpara, situate on a spur of the Garo Hills, is reached. Here, at the confluence of the Manás, and between the rocks of Jogighopa and Pagla Tek, is the "Gate of Assam," to the east of which Assamese is spoken, and to the west of it Bengali. Beyond this point the valley again widens, and at Dhubri opens out into the great Delta of Bengal.

The Brahmaputra is one of the greatest rivers in Asia, and is well known to be identical with the Yaro Tsanpo of Tibet. North of the Himalayas it has a course from west to east of about 1,000 miles, and under the name of the Dihong breaks through that barrier in the country inhabited by the Abors. The name Brahmaputra properly belongs to the much smaller stream into which the Dihong flows, and which rises in the province of Tibet called Zayul, and, passing Sadiya, receives the Dibong before it is joined by the Dihong. Throughout its course it is reinforced by a large number of affluents, great and small, those from the hills to the north generally having their sources in Himalayan snows, and being throughout the year of considerable volume, while those from the south in the rainy season carry very large bodies of water.

Except at the points already mentioned, where hills impinge upon the river and give permanency to the channel, the Brahmaputra flows in a trough through sandy alluvium which is subject to constant changes. Within this belt, which is several miles broad, there is no permanent cultivation, nor any habitation but temporary huts here and there, erected by people who grow patches of mustard on the

thin soil topping the sand during the cold weather. These flats are quickly covered, after being laid down during the rains, by a thick growth of tall coarse grass which shuts out the view of all the interior, and the traveller up the Brahmaputra in the cold weather receives the impression that the country is a wilderness untenanted by man, except where a rocky foundation has made settlement possible. These places are Dhubri, the capital of the Goalpara district, Goalpara, Gauhati, the capital of Kamrup, Tezpur, the capital of Darrang, Silghat, the port for Nowgong, and Bishnath, in the Darrang district. Between Bishnath and Sadiya, close to the point where the river emerges from the hills, a distance of about 200 miles, there is no town or large village on its banks, Golaghat being 20, Jorhat 10, Sibsagar 8, and Dibrugarh 5 miles away from the cold weather channel. Going inland from the river, one passes out of this trough into a drier region, where villages and permanent cultivation are found. In the western and central portion of the valley the waste is chiefly open savannah, covered with long grass from ten to twelve feet high, and studded with single trees, among which the *bombax*, or silk cotton tree, preponderates. In the upper portion, thick forest often comes down close to the stream, and the number of trees which fall into the river by the erosion of the banks, and remain as snags, are a serious danger to navigation. Beyond this peopled belt, on either side of the river, extensive forests stretch back to the foot of the hills on the north and south, and population again falls off. At the extreme end of the valley, under the Mishmi Hills, the forest is dense and almost uninhabited. The best peopled part of the valley is Sibsagar, excluding the extensive forests lately transferred to the district from the Naga Hills. Until 1891, it was the northern part of Kamrup in Lower Assam; but this region was severely visited by the great earthquake of June 1897, which raised the river-beds and depressed large tracts of country, completely disorganising the drainage system, so that extensive areas of good rice land were destroyed by floods and deposits of sand. The incidence of population in the whole valley is 108 per square mile, ranging from 197 in Sibsagar to 68 in Nowgong, a district which has lately been terribly devastated by a deadly form of malarial fever called *kala azar*. Deducting swamps and barren hills, it is estimated that there still remain in the Brahmaputra Valley as much as five million acres of good land awaiting settlement.

The Surma Valley.

The Surma Valley is a strong contrast to that of the Brahmaputra. It is much smaller in extent, less than one-third of the Assam Valley. Its mean elevation above the sea level is much lower, the cold-weather zero of the Surma at Sylhet being only 22·7 feet above the sea, while that of the Brahmaputra at Gauhati is 148·36. The course of the numerous rivers that traverse it is exceedingly sluggish, but the stream of the Brahmaputra is swift. While the latter hurries rapidly along through a waste of sandy *chars*, making and unmaking its margins year by year, the rivers of the Surma Valley find their way to the great estuary of the Megna by extremely tortuous channels, the banks of which, reinforced by the annual deposition of silt, are the highest ground in the alluvial area, and are, therefore, chosen for the village sites. Behind these banks the ground slopes away into great basins, called *háors*, which are for the most part dry in the cold and early hot season, but receive the outflow from the rivers as the rains progress, and for half the year are great lakes, on the margins of which deep-water rice cultivation is carried on. As the water recedes this cultivation is pushed further forward, and the abundance of moisture allows of a succession of harvests; there are in the deeply flooded portions of Sylhet three rice crops, the *áman* and *sail*, reaped between November and January, the *boro* or *bura*, reaped in April and May, and the *áus*, reaped between June and September.

To the north of Sylhet rises the steep face of the Khassi and Jaintia Hills, celebrated for having the greatest measured rainfall in the world. Seen from Sylhet, this barrier presents an almost horizontal line about 4,000 feet above the level of the plain, backed by a higher plateau rising to 5,000 feet. The land at the foot of these hills is many feet under water during the rains. In the short dry season it is covered with a dense growth of long grass, among which may be seen a pretty white and purple clematis, and a profusely-flowering white rose—remarkable as the only wild rose which grows in the plains of India. The river gorges opening on to the plain from the Khassi Hills, which carry away the tremendous rainfall of this region, are among the most beautiful scenery in the province. In the cold weather they are easily navigable by canoes for a considerable distance

into the hills. The high, precipitous cliffs, the rich tropical vegetation, the deep clear pools, thronged with fish making their way upwards to spawn, the rapids, where a reef crosses the stream, skilfully navigated by the boatmen, all present a picture which lives in the memory. One gorge is very like another, but each has some special attraction of its own. Near the eastern boundary of Sylhet the plateau of the Jaintia Hills recedes into the interior, and a new barrier, the angular and serrated range of the Baráil, or Great Dyke, takes its place as the northern face of the valley. This range gradually increases in height and precipitous character as one proceeds eastwards, and at the eastern extremity of Cachar takes a curve to the north-east, thereafter forming the main axis of the Naga Hills, and eventually merging in the Patkoi.

To the east the valley is shut in by the mountains of Manipur, and on the south the parallel ridges of the Lushai and Tipperah Hills extend into the plain, gradually retreating as the Surma river emerges from Cachar into Sylhet, but still preserving their meridional direction, until the Bengal district of Tipperah is reached. Throughout this great alluvial plain, except in the western portion adjoining Mymensingh, the surface is broken by frequent groups of low isolated hills, called *tilas*, which may be regarded as the continuation beneath the alluvium of the southern ranges. Except where these *tilas* and the southern ranges project, the whole valley is a vast alluvial expanse, covered with a perplexing network of sluggish streams, and liable to deep flooding in the rains, when one may sail unhindered over the greater part of its surface. In the south, the side valleys, each occupied by its river, reach higher levels; and it is along this southern portion that the railway from Chittagong is carried north-eastwards, crossing the Surma at Badarpur, where the Cachar district begins and the Sirispur Hills from the south impinge upon the river.

In Sylhet there is little forest, except on the southern hills stretching up from Tipperah, and in the great valley of the Langai and Singla rivers in the south-eastern corner. In Cachar the whole of the south of the district bordering on Lushailand, measuring more than 700 square miles, is a forest reserve, whence the whole valley draws its main supply of timber. The population of Sylhet is dense, 412 to the square mile, and the density increases towards the Bengal border, where, in Habiganj, it is 560 to the square mile. In Cachar the density is only 201, but much of the district is hilly and under reserved forest. The hills and valleys in the south of Sylhet, the *tilas* in the north, and the higher land under the Jaintia Hills, are the parts of the district where tea is grown. In Cachar there are gardens throughout the district.

The Assam Range.—I. The Shillong Plateau.

The Assam range consists of two regions of very different geological characters. The first is a great table-land, called by geologists the Shillong Plateau, including the Garo Hills, the Khassi and Jaintia Hills, Cachar north of the Barail, and the Mikir Hills. It consists of a great elevated mass of gneiss, which on the north has been denuded of all more recent formations, and is broken into hills, for the most part low and very irregular in outline. In the central region the gneiss is covered by transition or submetamorphic rocks, consisting of a strong band of quartzites overlying a layer of earthy schists. In the centre of the range, where the tableland attains its greatest elevation, masses of intrusive diorite and granite occur in a line running east and west, and south of this main axis fossiliferous strata commence, belonging to two series, the cretaceous or older, and the nummulitic, the more recent. These increase rapidly in thickness as one proceeds southwards, until on the southern margin the whole series bends downwards almost at right angles, and disappears below the alluvium of the Surma Valley. Both the cretaceous and the nummulitic series contain several beds of coal, some of which are of considerable extent and importance. There is a large coalfield on the Somesari River, at Darranggiri in the heart of the Garo Hills, which is estimated to contain some 300 million tons, and a very extensive field at Langrin on the Jadukata River in the Khassi Hills, in a very accessible situation; the seam, however, though believed to cover about thirty square miles, is only some three feet thick. These belong to the cretaceous series. The nummulitic coal is found at Cherrapunji, Maolong, Lakadong, and a few other places within the Khassi Hills, but generally in localities difficult of access from the plains. In the face of the Khassi and Jaintia Hills towards Sylhet nummulitic limestone occurs, which has for centuries been the most important lime supply of Bengal.

The elevation of the Shillong Plateau is highest in the Khassi Hills, where in the

Shillong Peak it reaches 6,500 feet above the sea. The general level of the tableland in this region is 6,000 feet, and Shillong itself is at 5,000, on a shelf north of the main axis, being thus protected by the higher plateau from the excessive rainfall of Cherrapunji on the southern face, less than 30 miles distant. The Garo Hills reach in their highest portion 4,600 feet, but the greater part of the district is considerably lower, Tura, the capital, being situated on a shoulder 1,323 feet above sea level. East of the Khassi Hills the level falls, the highest summits in the Jaintia Hills not much exceeding 5,000 feet, while the North Cachar Hills (excluding the Barail) are not more than 3,000. The Mikir Hills to the north have points reaching 4,000. In the Khassi Hills the upper plateaus are open downlike country, covered with grass and fern, and studded with sacred groves, chiefly of leafy trees, rhododendron, oak, castanopsis, magnolia and cinnamon. Where not under cultivation the land rapidly becomes covered with a thick growth of an indigenous species of pine (*pinus khasia*); the other vegetation on the whole greatly resembles that of the upper portions of Sikkim. The lower regions to the north are thickly wooded, but the axe and fire cultivation pursued by the tribes prevents the growth (except in favourable localities) of large timber, and the jungle is chiefly composed of saplings and bamboo. In the Garo Hills patches of *sal* forest are found all over the northern half, and the central higher range, which is a sacred reserved forest containing Chikmang, the Garo Paradise, is well wooded; but in the lower hills bamboo predominates. In the lower parts of the Garo Hills wild elephants are very numerous, and the Government *khedda* has for years worked this region with great success, capturing between 200 and 300 animals annually.

II.—The Barail.

The second portion of the Assam range is the Barail, which commences in North Cachar, and includes the Naga Hills district. It opens out into the plains of Cachar by the deep Jatinga Valley, up which now runs the Assam-Bengal Railway, joining the Surma to the Brahmaputra Valley. In the hills to the north and south of this, summits of from 5,000 to 6,000 feet are found. Passing north-eastwards, the range attains still greater height where it forms the boundary between the Naga Hills and the State of Manipur, until the highest elevation within the Province is reached in the peak of Japvo, a little less than 10,000 feet above the sea. To the north-east of this the mountain system of the Barail is broken up into a number of ranges having a generally north-east and south-west direction, until the Patkoi is reached. In this region the highest points are from 8,000 to 9,000 feet. Snow is frequent on Japvo and its neighbourhood, but seldom falls further west. The Barail consists of soft massive greenish sandstones of tertiary age, greatly disturbed, and overlying, in the higher portions about the peak of Japvo, hard sandstones, slates, and shales. The north-eastern face of this region contains several very important coalfields, which form at present the chief mineral wealth of the province. The largest field is at Makum on the Buri Dihing river, where there is a seam 100 feet thick containing at least 75 feet of solid coal. There are others further west, at Jaipur on the River Dihing, and near the exits from the hills of the Dikhu, Safrai, Jhanzi, and Disoi rivers. Petroleum is found in abundance in the neighbourhood of the Makum coalfield, and elsewhere there are indications of it in Cachar and the Khassi Hills. Throughout the Barail system forest predominates, but here also axe and fire cultivation restrains the growth of large timber. The vegetation of the whole of the Assam range is extremely interesting from a botanical point of view. While the flora in its general character resembles that of the eastern Himalayan region, there are a number of types to be found belonging to China (among which may be mentioned camellias, including the tea-tree, numerous species of magnolia and several ferns), while others belong to the Burmese and Malay flora, stretching up from the south. The range is thus the meeting-place of three distinct botanical regions. Among its most beautiful productions are a great variety of orchids, many species of balsams, several charming rhododendrons, and a great abundance of begonias and hedychiums. It is the home of the tea-tree, and the purest form of Assam tea, as grown in the gardens in the plains, is derived from seed gathered in the forests south of the Buri Dihing river, or in the hills between Manipur and Burma. Another valuable product of the forests of Assam is rubber, yielded by the *Ficus elastica*.

The Population of Assam.

The population which inhabits this great territory, including the Manipur State, numbers 6,126,343, of whom $5\frac{1}{4}$ millions live in the plains districts, divided nearly evenly between

the two valleys, rather more than half-a-million in the British hill districts, and 284,465 in Manipur, which is also a portion of the mountainous region. It is doubtful whether there is any part of Asia where so small a population presents such great diversities of ethnical type. Like the flora, mankind in Assam is the product of the meeting and interaction of many different races of men, and thus offers a most interesting subject of study to the anthropologist. In physical characteristics, in language, in religion, and in all the degrees of human culture, there are the widest differences. And it is where such differences meet, and contrasts are greatest, that students find the most fruitful field of observation. I cannot, in the short time allowed me, attempt more than the briefest summary of the facts.

(1) Immigrants.

A great proportion of the six millions now found in Assam are recent immigrants. At the census of 1901, the number of persons born outside the Province was 775,844, but to these original immigrants must be added many more of the second and third generation, born in the Province, who were not separately censused as strangers. About half a million came from Bengal, and at least two-thirds were dark-skinned people of Dravidian and Munda race, from the highlands of Chota Nagpur, Sorthalia, and the hilly tracts of the Central Provinces; the rest were chiefly from the North-West Provinces and Behar. Excluding these foreigners, who are nearly all found in the tea districts of the plains portion, the indigenous population consists, broadly, of two widely different stocks —the Aryans, or at least the representatives of Aryan culture, Hindus and Mohammedans, and the Indo-Chinese races, among whom they have inserted themselves. In the hill districts only the latter are found; and in the two valleys a large proportion of the population is of aboriginal blood, though strongly affected by the absorptive power of Hinduism and Islam. It is not possible, from the census data, to divide off the Aryan from the Indo-Chinese; but we can at least point to the races unaffected by the missionary religions as representing with considerable purity the original population of the country.

(2) Indo-Chinese Races.—(*a*) The Khassis.

The Indo-Chinese races in Assam fall apart into three great divisions, which have in common only a general Mongolian aspect, an aversion to the use of milk in any form, and a great difference in physical characteristics, speech, and institutions, from the Aryan settlers. The first of these is represented by the Khassis, 177,802 in number, who are believed to be an isolated remnant of the first wave of Indo-Chinese immigration in its progress to the south. They have no relatives within the province. Their nearest kindred are a number of scattered tribes hundreds of miles away beyond the frontier, in the mountains of Upper Burma, called Palaungs and Was; but they belong to the same group which, much advanced in civilisation, is represented by the Talaings in Pegu and Tenasserim, and the Khmers of Cambodia. The Khassis are a matriarchal people, their institutions being based entirely on mother-kinship. They do not practice polyandry, but the place of women, as the sole holders of real property and transmitters of inheritance, is so highly regarded that that sex is able to show great independence in marriage relations. They burn their dead, and erect rude stone monuments to their memory, depositing the ashes in a common tribal receptacle of stone in the midst of a sacred grove. The plateau is studded with innumerable groups of standing and table stones, set up alongside of the paths from village to village as memorials of those who have passed away, and the resemblance to the similar megalithic monuments of Western Europe and the British Isles is very striking. They are good cultivators, growing a variety of crops, and ready to adopt any new staple that promises to be profitable, as for instance potatoes, of which they produce large quantities for export. They have large orange groves at the foot of the hills in Sylhet, which supply the best oranges in the Calcutta market. They are enterprising traders, and almost the only people in the province who voluntarily accept service as porters. All our expeditions in the hills between Assam and Burma have relied upon them for coolie transport. I first went to Assam in April, 1880, when the last Naga war had just been brought to a close by the submission of the Angamis. Many of the Khassi coolies had died in the campaign, and I remember that one day in the rains, when I was driving down from Shillong to Gauhati, I observed that every gutter carrying water across the road, as well as the bridges over larger streams, was crossed by a cord stretched carefully from side to side. On inquiry I learnt that these cords were put there in order that the ghosts of the dead might

travel up them to the ancestral land above, and join the rest of their race. Ghosts, as is well known in Europe as well as in Asia, cannot get across running water, and the cord was meant to give them a bridge. Where there were bridges already the cords were scarcely required; but the ghosts were probably thought unlikely to recognise the work of European strangers as sufficiently safe to travel by without the string required by tradition. The Khassis are great drinkers, using a strong spirit made from rice. They do not smoke, but consume large quantities of betel-nut mixed with lime, the effect of which is to destroy the teeth and greatly to disfigure the face generally; distances are computed by the number of betel-nuts which can be chewed on the way.

(*b*) The Tibeto-Burmans.

The second great division of the Indo-Chinese are the Tibeto-Burmans, who constitute the original pre-historic population of both valleys, and of all the hills not inhabited by the Khassi race. It is impossible to say precisely what proportion of the present population of Assam should be classed under this head. It certainly includes all who continue to speak Tibeto-Burman languages, the Bodo or Kacharis, the Deuris or priests of the Chutiyas, the Garos, the Lalungs, the Rabhas, the Meches, and the Tipperahs, forming the Bodo group; the Nagas of many different tribes and tongues, and the Mikirs, forming the Naga group; the Kukis of manifold sections, including the Meithei or Manipuris and the Lushais, forming the Kuki group; the Singphos or Kachins, apparently an outlier of the Naga group; and the Eastern Sub-Himalayan group, consisting of the Daflas, Miris, Abors and Mishmis. Besides these it also includes many races which, though they have lost their tribal language and now speak Bengali or Assamese, show by their names that they are outside the pale of Hinduism, though conforming, more or less, to its practices. Of these the chief representative is the Koch or Rajbangshi, of which tribe the Maharaja of Cooch Behar, well-known in this country, is the head; in addition may be mentioned the Chutiyas and the Morans, members of the Bodo family, who inhabit Upper Assam and now speak Assamese. These are all evidently Tibeto-Burmans. But in addition it is reasonable to suppose that a considerable proportion of the plains population of both valleys, now included in the Hindu and Mussulman pale, is also of Tibeto-Burman origin. Their features bewray them. I once had a Mussulman table-servant whose home was in Pargana Bikrampur, in the Dacca district. His language was Bengali, and he had no knowledge of his ancestors ever having been other than Mohammedans. He had a broad and heavy face, and when I took him with me to the Garo Hills I saw many Garos of exactly the same type: it was evident that he too was of Garo descent.

Time would fail me to attempt a description of this important division of the population, containing so many different types, and speaking a large number of languages mutually unintelligible. Many of them, the Angami Nagas in particular, are very fine specimens of humanity—handsome, athletic, accustomed for generations to dominate their surroundings, and having the characters of a ruling race; the Manipuris, since they assumed Hinduism about the beginning of the 18th century, have made considerable advances in civilisation, and display a faculty of governing less cultivated tribes, which has enabled them to bring a large area outside the valley of Manipur under subjection. Other races of the stock are dull and unprogressive, some timid and unwarlike. But all deserve careful examination, affording as they do the best possible subjects for anthropological and linguistic inquiry, and presenting the more primitive conditions out of which have emerged the two great civilised populations of Tibet and Burma, which flank them to the north and south. Perhaps two-and-a-half millions of the population may roughly be set down as of Tibeto-Burman stock.

(*c*) The Shans.

The third division of Indo-Chinese inhabitants of Assam is a branch of the great Tai race, to which belong the Siamese of Siam and the Shans of Burma and the Upper Menam and Mekong valleys. This includes the Ahoms, who were formerly the ruling race in Assam proper, and invaded the valley from the Shan kingdom of Mogaung in the year 1228 A.D., and several small colonies of Shans, called Khamptis, Phakials, Aitonias, Noras, and Turungs, who have recently settled in Upper Assam from beyond the mountains. The latter retain their ancestral language and are a civilised people of Buddhist creed, who set store by education, and have in every village a monk who instructs the boys in reading, writing, and religion. The former,

who number 178,049, now all speak Assamese and profess to be Hindus. They have largely intermarried with the Tibeto-Burman races, the Ahom Kings of Assam contracting alliances with the Princesses of the Manipur, Tipperah, and Cachari dynasties. Only a few persons are now able to read the old Ahom books, which contain the history of the dynasty, and the scriptures of their religion. But these records are particularly interesting, the first as giving the only contemporary and authentic historical account of the province, and the latter as exhibiting the creed of the Shans of Upper Burma while they were still pagan, and before they were absorbed by Buddhism.

(3) The Hindus.

The Hindus, as is well known, are as a race wanting in the historical instinct, and we know nothing for certain of the first settlement of Aryans in Assam. The epics and *puranas* of Gangetic India contain names which are now identified by the people with sites in the Province, but many of these are also claimed, probably with better reason, by other parts of India. The Pándu brothers of the Mahabharata are popular heroes, and the story of Krishna brings him up the Assam Valley to the City of Bhishmaka, under the Mishmi Hills, at its northern extremity, where he won his bride Rukmini. In fact, as in Java and elsewhere in Further India, Aryan immigrants have carried with them their heroic legends, and found for them a local habitation in their new home. The immigration must have been early, for the first authentic record we possess, that of the Chinese monk and pilgrim Hiuen Thsang, who visited Kamrup shortly before 640 A.D., speaks of kings of Prágjyotishapura, the modern Gauhati, who had a long line of predecessors. The country he saw was then given over to the Brahmanical religion, though he heard of barbarian tribes higher up the valley who were pagans, like the uncivilised mountaineers of China.

After Hiuen Thsang, authentic history fails us. Such traces as are left, in inscriptions and copper-plates recording grants of land to Brahmans, appear to show a progressive Hinduisation of the country, and a number of petty States, ruled over by chiefs, probably of Tibeto-Burman origin, but under the guidance of Hindu advisers, and conforming to Hinduism. The early celebrity of the temple of Kamakhya at Gauhati, and its importance as a centre of that bloody and sensual form of worship of Siva and his Consort called *Tántrik*, are beyond question. The renown of this *Tírtha* is spread not only throughout Assam, but also in Bengal; and the chief scriptures of the Tántriks in the latter province reckon Kamakhya, in Kamrup, as their most notable holy place. What we know of the religion of the Hinduised aboriginals shows that it conformed generally to this sanguinary type. Human sacrifice was common. About 1565 A.D. the Koch king Nar Narayan rebuilt the temple of Kamakhya, and consecrated it with numerous sacrifices, including 140 men, whose heads he offered to the goddess on copper plates. On another occasion he offered, at a temple at Hajo, 700 men. Similar bloody sacrifices are alleged by tradition to have been common at the capital of the Kachari king, Dimapur on the Dhansiri, and afterwards at Maibong. Near Sadiya, at the copper temple of the goddess worshipped by the Chutiya kings, human sacrifices were offered yearly until the time of Gaurinath, the Ahom king who was ruling in 1790, and in whose days that kingdom fell to pieces. And later still, the Rajas of Jaintia in North Sylhet, on three different occasions between 1821 and 1832, sacrificed human victims to Kali; the last of these outrages leading to the confiscation by the British Government of the Raja's territory in the plains. In the Assam Valley there are 57,000 Brahmans, 15,000 Ganaks or astrologers, and 15,600 Kayasths. These castes are representatives of Aryan culture, with high domed foreheads, and high aquiline noses—a great contrast to Tibeto-Burmans. Other important Hindu castes who may be of Aryan origin, or at any rate were Aryanised before they settled in Assam, are the Kalitas (202,845), the Kewats (103,141), and the Nadiyals or Doms (80,500). The other castes returned as Hindus are probably the result of conversion, which must have been a long and gradual process.

History of Assam Valley.

After Hiuen Thsang the next accurately fixed date is 1228 A.D., when the Ahoms invaded the country from Mogaung, in Upper Burma. They found established in Upper Assam a dynasty of partially Hinduised Chutiya kings, of the Bodo race, with whom for some centuries they contended for the mastery. Gradually the Ahoms spread along the south bank of the Brahmaputra, and came in contact with the Kachari kings who then ruled Central Assam, and had their capital at Dimapur in the Dhansiri

Valley, under the Angami Naga Hills. The Ahoms defeated the Kachari king in 1488, and so harassed him that, in 1536, he removed his capital into the centre of the Cachar Hills at Maibong. The Chutiyas were finally subjugated about the same time, and the Ahom kings thus became lords of the whole of Upper Assam. During this time in Lower Assam and the adjacent sub-Himalayan territories of Bengal there had been set up a Koch kingdom, ruled by Hinduised Bodos, the kings of which rapidly increased in power, and faced the Ahoms in their progress down the valley, which was thus arrested for a season. At last, in 1637, the Koch kings were overthrown by the Mohammedan rulers of Bengal, who occupied the valley as far as Gauhati. The latter have left strong traces of their administration in the Kamrup district, which they held for many years. In 1660 the Mughal governor of Bengal under the Emperor Aurangzeb, Mir Jumla, attempted the conquest of the Ahom kingdom, and led an expedition up the valley. He was successful in capturing Garhgaon, the Raja's capital; but the climate and the strange country told heavily on his army, and eventally he had to lead his forces back with great losses of men and animals, and he himself died of dysentery shortly after his return to Bengal. After this the Mughals gave up Kamrup, which then fell to the Ahoms, and fixed their frontier at Goalpara on the south bank, and the river Manas on the north.

The Ahom king, whose predecessors had already fallen under the influence of the Brahmans, formally became a convert to Hinduism in 1655, and henceforth all the kings bear both Ahom and Hindu names. The greatest of them was Rudra Singh, or Chu-kungpha, who came to the throne in 1695, and reigned 19 years. He completed the conquest of Lower Assam, made the remnant of the Koch kingdom in Darrang part of his dominions, carried a survey through the whole of his kingdom, encouraged trade and diversity of occupations, and organised his subjects into an administrative system which is unique in the plains of India, and the effects of which still influence the people of Assam.

Ahom System of Administration.

In the rest of India we are accustomed to regard the village as the unit of society; and the similarity between the Aryan community as thus organised, and the European village commune, has often been brought forward as a proof of the unity of origin of the Indo-Aryan and European races. But in Assam proper there are no village communities; the whole able-bodied adult male population (except the slaves, who were numerous) was divided into groups of four persons, called *gots;* the individuals forming these *gots*, called *paiks*, were bound to render personal service to the king, or the great officers of the kingdom to whom they were assigned, in war and peace. Each man gave three months' labour in the year to the State, and the remaining three *paiks* who stayed at home cultivated the land which the *got* held for its sustenance. At the head of a number of *gots*, called *khels*, was placed an officer, and there were gradations of officers bearing different names corresponding to their rank and the number of *gots* under them, up to the highest, the *Bor Barua* in Upper Assam, and the *Bor Phukan* in Gauhati. These two were the king's chief ministers, and the offices were hereditary in certain families. In addition to the ministers, there was a council consisting of the heads of three families, the most powerful of the Ahom aristocracy, called the *Bor Gohain*, the *Bura Gohain*, and the *Borpatra Gohain*. Besides these there were inferior *Baruas* and *Phukans* over every department of industry and of administration, charged with the supply of all that was needed for the State service. There were *khels* devoted exclusively to fishing, others to manufactures, besides cultivation, which was of course then as now the chief occupation of the people. The king's revenue was thus paid mainly by personal service, and, in the case of manufactures and articles needed by the court, in kind; but service could be commuted in peace time for a money payment, and there were also payments to be made in money for land occupied in excess of that allowed free for the maintenance of the *paiks*. Like the king, all the great officers of state had allotted to them the services of *paiks* for their support: their salaries were paid in men, not in money. They also had large numbers of slaves, who cultivated their estates. In time of war this organisation became a national army, of which the taskmasters and superiors were the officers. In time of peace the labour of the agricultural *paiks* was utilised in great public works. The district of Sibsagar, where the capital of the Ahoms, Garhgaon, and afterwards Rangpur and Jorhat, was situated, is covered with a network of embanked roads made by the *paiks*, besides many noble tanks, and embankments

keeping within their courses the rivers which flow from the Naga Hills into the Brahmaputra, and thus ensuring the safety of cultivation. The *khels* seem to have had very little attachment to particular spots as their ancestral home, and readily shifted from place to place. There was no self-government, such as prevails in the Aryan village community: administrative centralisation under an immense bureaucracy was the prevailing type.

This was the condition of things in Upper Assam, the original seat of the Ahom kingdom. In Lower Assam, however, which was Koch, not Ahom, till the first half of the 17th century, and had then been brought under the sway of the Mughals, the system was somewhat different, and the Ahoms never succeeded in imposing their organisation there in its completeness. Kamrup had been divided by the Mussulman Governors into *parganas*, and placed under chiefs called *chaudhris*, who paid revenue in money. A large proportion of its area was assigned, either revenue-free or at favourable rates, to temples and religious institutions; and round these nuclei communities, chiefly bound together by the tie of common dependence on a religious superior, grew up. But though habitation and occupation of land in Kamrup is much more settled and permanent than it is in Upper Assam, even here the villages are wanting in that well-furnished constitution which marks the Aryan village elsewhere. Each cultivator is responsible for his own land and revenue, but not for those of his neighbour. There are no village servants, nor village heads, except the oldest member, whom the others agree to obey; and we have found the greatest difficulty in creating any sort of representative of the village community with whom Government can deal as the local headman. Indeed, the problem is not yet solved.

Religions of the People.

Religion played a large part in the organisation of society in the Assam kingdom, and this part survives almost unaltered to the present day. The Tibeto-Burman aborigines are Animists, and outside the Hindu pale; but within the ever-widening limits of Hinduism the influence of religious heads has for centuries been the most important force in society. Originally, the type of Hinduism must have been almost universally Saivist or Sákta, the people worshipping Siva and his Consort, whose rites, as already mentioned, involved bloody sacrifices at which the victims were often men. The kings of Assam, whether Ahom, Chutiya, Kachari, or Koch, appear to have always remained faithful in their Hinduism to Siva. But in the 15th century, a Kayastha named Sankar, born in Kamrup, whose mind revolted from the sanguinary rites which he saw around him, went on a pilgrimage to Bengal, and then became acquainted with the great Vaishnava reformer Chaitanya, whose tenets he adopted. Vaishnavism, as preached by Sankar and his disciples Madhab, Damodar, and Hari Deb, rejects idolatry and the divisions of caste, and stimulates religious fervour by fixing the mind upon the person of Vishnu, and the history of his incarnation Krishna, and by constant recitation of hymns and spiritual songs. Its followers abstain from animal food and intoxicating drink, and reprobate the taking of life. Some of them adopt an ascetic rule, and among the many heads of institutions derived from the teaching of Sankar and Madhab, several are celibates.

The original purity of Sankar's teaching has not been maintained by his fellows. The Mahapurushiyas, as the sect is called in Kamrup, allow the eating of flesh of other than domestic animals. Caste still dominates society, and Damodar and Hari Deb, who were Brahmans, while the other reformers were Kayasthas, set up again their own order in the seat of priestly authority. But in spite of these declensions, there is an immense difference between the religion of Vaishnavism and that of the Saktas and Saivas, whose creed prevailed universally before, and still has many representatives. Lower Assam has a great number of Vaishnava religious communities, called *shattras* or *shastras*, of which the chief is that at Barpeta in Kamrup, where disciples, called *bhakats*, lead a common life of devotion under the governance of an *adhikár*, or superior. In Upper Assam the chief seat of the religious communities is the long island in the Brahmaputra called the Májuli, which divides Sibsagar from Lakhimpur. The Gosains of the Majuli, the chief of whom are those of the Auniháti and Dakhinpát *shattras*, or colleges, are extremely influential religious leaders. Their emissaries, called *medhis*, are to be found throughout Upper and Central Assam, enforcing obedience to the rules of the order, levying a religious tax from the enrolled disciples of the Gosain for the support of the *shattra*, deciding controversies in the *námghar*, or general meeting-place (for religious purposes) of the community, and extending the influence

of their chief by bringing within the circle of his *bhakats* the Tibeto-Burman tribes outside the pale of Hinduism. In this aspect Vaishnavism is a truly missionary religion; and each succeeding census has shown that it is radically altering the ancestral habits of people who till now had no pretensions to be called Hindus at all. When Kacharis, Miris, Mikirs, and Nagas are found to be ready to give up eating meat and drinking rice-beer—of both of which the natural man is immoderately fond—in order to level themselves up to the standard of their spiritual chief, it cannot be said that the Hindu religion has lost its power of assimilation. And in Assam we see going on under our eyes that process which, in prehistoric times, spread the religion of the Aryas through the non-Aryan millions of Gangetic and Peninsular India.

Moamaria Rebellion and Downfall of Ahom Kingdom.

This process of conversion by the Gosains was the immediate cause of the downfall of the Ahom kingdom. In the reign of Lakhmi Singh, the youngest of the four sons of Rudra Singh, who became kings one after the other, a sect called the Moamarias, headed by their Gosain, raised a formidable rebellion in the country between the Buri Dihing and the Brahmaputra. Lakhmi Singh's capital was taken and himself deposed; but the Gosain and his immediate following were afterwards captured by a stratagem and put to death, Lakhmi Singh being restored. In the reign of his son and successor Gaurinath, in 1784, the Moamarias again rose, and, after many engagements, Gaurinath was forced to leave Upper Assam, and took refuge at Gauhati. From this point he sent troops up the valley, and his relation by marriage, the Raja of Manipur, also sent a force across the Naga Hills to his assistance. Both, however, were defeated by the Moamarias, who ravaged the whole of Upper and Central Assam. The Koch Raja of Darrang, Krishna Narayan, seeing his opportunity, rebelled, and made an attack on Gauhati, reducing Gaurinath to extremity. The latter now appealed to the British Government for aid. Lord Cornwallis, who was then Governor-General, sent a force under the command of Captain Welsh to his assistance in 1792, and thus for the first time the British came into relations with the Ahom kingdom. Captain Welsh, starting from Goalpara, was met halfway on the road to Gauhati by the Raja, and had no difficulty in driving out the Moamarias, who had occupied that town on the south bank, and in routing the Darrang Raja Krishna Narayan, who held the north bank. He then advanced into Upper Assam, put down the Moamarias, and replaced Gaurinath in authority. At the same time he convened a council of the officers of State, and made a full inquiry into the institutions of the kingdom, and the measures necessary to restore order and to secure good government to the people. His interesting report may be read in Sir Alexander Mackenzie's "North - Eastern Frontier of Bengal." He proposed the permanent retention of a brigade of British troops in Assam, for the payment of which the revenues of Lower Assam were pledged by the Ahom Government, with the full consent of the Council of Ministers and the officers of State. Had Captain Welsh's plan been adopted, Assam might still be a Native State, governed by its own chief under the guidance of British officers, and the people would have been spared the miseries and massacres of the next thirty years. But in 1793 Lord Cornwallis left India, and his successor, Sir John Shore, decided on a policy of non-intervention, and recalled Captain Welsh. Gaurinath died a few months after Captain Welsh's departure, and the Chief of the Council of nobles, the Bura Gohain, named Purnananda, who was the most conspicuous figure in Assam during the next 20 years, set up Kamaleswar, a puppet ruler who reigned till 1809. On his death Chandra Kanta, his brother, succeeded, and endeavoured to get rid of the Bura Gohain. The plot failed; but its prime mover, the Bor Phukan, or Governor of Lower Assam, who had fled to Calcutta, met there an agent of the Burma Government, and went with him to the capital of Burma, Amarapura, whence a force was despatched across the Patkoi to the assistance of Chandra Kanta. The Raja was replaced in power, and the Bura Gohain and his adherents fled to Gauhati. On the retirement of the Burmese, Chandra Kanta was so ungrateful as to put the Bor Phukan to death, and endeavoured to entice the Bura Gohain to Rangpur in order that he too might be disposed of. The latter, however, was not to be trapped, but set up a rival Raja, Purandar Singh. In 1816 Purandar was proclaimed, and the Bura Gohain accompanied him with an army from Gauhati to Jorhat. Chandra Kanta was persuaded to a conference, and seized and made prisoner. Meantime the family of the murdered Bor Phukan fled

across the hills to Burma, and returned with an army of 30,000 men. In 1818 Chandra Kanta was replaced on the throne, and Purandar and the Bura Gohain fled to Bhutan. In 1820 Chandra Kanta caused the new Bor Phukan to be murdered, and the Burmese returning with a powerful army expelled him from Assam, and set up a third Raja in his place. Chandra Kanta now from his refuge in British territory made several attempts to regain a footing in Assam, and the province was ravaged by constant warfare for the next three years. At last, in 1824, in consequence of events occurring elsewhere, on the frontier of Chittagong towards Arakan, war was declared by the British Government against Burma, and the Burmese were ex-expelled easily from Cachar, which they had occupied, and, in the course of a two years' campaign, from the Assam Valley also.

British Rule.

By the treaty of Yandabo, signed in February 1826, the King of Ava ceased to claim dominion over Assam, Cachar, and Jaintia, and the destinies of the Province passed into British hands.

It was in a miserable condition:—

"Thirty thousand Assamese had been carried off by the Burmese as slaves when they retired from the Assam Valley. Many thousands had lost their lives, and large tracts of country, especially in the north-east, had been laid desolate by the wars, famines, and pestilences, which for nearly half a century had afflicted the province. The remnant of the people had almost given up cultivation, supporting themselves chiefly on jungle roots and plants. The nobility and priestly families had retired to Goalpara or other refuges in British territory, often after losing all their property; and with them had gone crowds of dependents, glad to escape from the miseries of their native land.*

We had now to choose between the three claimants to the throne, and to decide what should be the future government of the Province. After much consideration it was determined to revert to the plan proposed by Captain Welsh 32 years before. Purandar Singh was selected to be the ruler of Upper Assam, consisting of Sibsagar and Lakhimpur, and Lower Assam was retained as British territory to pay for the cost of protecting the province from the attacks of the tribes who, during the years of disorder, had ravaged its borders. Purandar Singh held his principality, however, only from 1832 to 1838; he proved quite incapable of administering it, the revenues falling off, and the tribute of Rs.50,000 which he had agreed to pay being always in arrears. Finally, in October, 1838, he relinquished Upper Assam, which was resumed by the British Government and the Raja given a pension.

The thirty-five years from 1839 to 1874, during which Assam was incorporated in the Province of Bengal and governed from Calcutta, was a period of slow but steady recovery from the disasters of the previous century. Slavery was abolished, with the result of impoverishing the Ahom aristocracy, who depended on the slaves for their cultivation. The revenue demand, previously taken in the shape of labour, was commuted to a money payment. This had the somewhat unexpected effect of almost destroying the industries of the Province; for the *paiks*, being now free men, preferred to cultivate the soil rather than pursue the occupations which had been imposed upon them by the Ahom rulers. For instance, the *hunwáls*, or gold-washers, who in the time of the Rajas were required to contribute annually per man a fixed weight of gold, washed out of the sands of the many auriferous streams in Upper Assam, found that it paid much better to grow rice and live at home at ease. Thus the production of gold, for which the Province was once famous, entirely ceased. Personal service, which had been the ruling principle of the Ahom Rajas, was so hated that the rendering of any kind of labour to another was looked upon as derogatory, and to this day such service is most difficult to procure for the purposes of Government. The network of embanked roads, being no longer maintained by the armies of *paiks* who were set by the Rajas to work on them, became in most cases overgrown with jungle, only the most necessary being kept open for traffic. The river embankments in Sibsagar fell into decay, because there were no hands to repair them. Such were the embarrassing, though not unnatural, results of the introduction of British ideas of liberty and equality into a territory which for centuries had been governed upon entirely different principles.

Land was a drug; anyone could occupy and cultivate as much as he required. But the natural increase of the indigenous population in Assam is now known to be extremely slow, and the great tracts of forest and waste, which had been depopulated in the troubles of the past, would have taken centuries to fill

* Quoted from Mackenzie's "North-Eastern Frontier," p. 7.

again if they had been left to be re-occupied by the native Assamese. Prices were extraordinarily low, and so were wages. When Mr. Robinson wrote his account of the Province, in 1841, the wages of a day labourer are said to have been two rupees a month, and he was well able to support a family on this sum, for rice was sold at two maunds, or 164 pounds, for a rupee. I have myself known officers in Assam whose service dated from the early sixties, and who remembered those times, when all the immediate necessaries of life were extremely cheap and abundant. Trade was then, as it is even now, in the hands of energetic merchants from Marwar in Rajputana; the Assamese have no trading class of their own. Their industries are still entirely domestic. Silk clothing is commonly worn, but there is very little of the material for sale. The worms are reared by the people on their homesteads, and the thread is spun by the women of the family, and the cloth made worn by the male and female members. No success, in spite of many persevering efforts, has attended the endeavour to get the people to cultivate silk for export, though the three descriptions commonly produced, called *pát*, *muga*, and *eri*, are very useful and superior articles.

Rise of Tea Industry.

One thing, and one thing only, has been the root and origin of what progress has been achieved in the valley of Assam, and that is the tea industry. Tea was discovered in the forests of Upper Assam by a Mr. Bruce while the Burmese were still in possession. Captain Jenkins, the Commissioner, in 1835, induced the Government to start nurseries of the tea plant between Sadiya and Dibrugarh, where a garden still called *Chabua*, or "place where tea was sown," marks the site of the first attempt to grow the plant for commercial purposes. Chinese were imported to teach how tea should be made up for market, and Chinese seed was introduced, much to the detriment of the original indigenous strain. The first boxes of tea for the market were turned out in 1837, and well reported on, and in 1839 the Assam Company was formed to take up the cultivation. The Government gardens in the neighbourhood of Jaipur, south of Dibrugarh, were transferred to the company, who established their headquarters at Nazira, about seven miles east of the capital of the Sibsagar District. The concern had its vicissitudes, and it was not till 1852 that its prospects began to improve. In 1859 the Assam Company had about 4,000 acres under cultivation, and other gardens had been opened by private persons in Sibsagar and Lakhimpur by 1853, and in Darrang and Kamrup in 1854. By this time the labour difficulty began to be acutely felt, and as no indigenous supply was, for the reasons already stated, procurable, it was necessary to import it from outside. The first attempts were, as was natural in the circumstances, badly organised, and great mortality occurred both during the transport of coolies to the tea districts and after their arrival there. A succession of Acts were passed by the Government of India for the purpose of regulating the traffic and the conditions of employment, and these form the foundation of the legislation on the subject which is still in force, the last revision of the labour and immigration law having taken place in 1901. In 1866 there was a serious crisis in the industry, which, as often happens, had been pushed on too fast and without the necessary knowledge and experience, and many concerns collapsed. About 1869 things began to recover, and the tea industry is now, I think it may be said, well established on a sound basis. In the Brahmaputra Valley there are now 205,352 acres under tea, which in 1901 yielded an outturn of 72,530,000 pounds. In the Surma Valley the acreage is 132,834, and the outturn 62,365,000 pounds, a total for the Province of nearly 135,000,000 pounds.

I have already mentioned the vast addition to the population of the Province which has been introduced by the tea industry. The labourers employed on estates in 1901 numbered at the end of that year 644,758. But in addition to these, great numbers of people who originally came up as coolies have settled as cultivators of the soil on their own account, or drive a thriving business as carters, graziers, and dairymen. As I have said, the census of 1901 showed nearly 776,000 to have been born outside the Province, and the families of foreign settlers born within Assam may have amounted to as many more.

It is not only in extending cultivation and increasing population that the Province owes its progress to the tea industry. The very high prices which now prevail for all articles of indigenous produce are entirely due to that cause, and these high prices have had their natural result in stimulating trade. The rivers are the chief and natural highways of traffic. But anyone accustomed to the busy scene which meets the spectator on the rivers of the Bengal delta will be surprised at the deserted

nd empty appearance of the waters of Assam. Built boats are unknown on the Brahmaputra above Gauhati, and those which get up so far were all put together in Bengal. The indigenous craft of the Assam Valley is the dug-out, hollowed by means of fire and adze from entire trees—a craft without a keel, by no means comfortable as a means of transport, and liable to get crazy very early in its career, owing to the fact that it is made of the outer wood of the tree, and not of the hard heart-wood. The traffic of the valley is practically carried on by the steamers, which owe their introduction to the tea industry, to whose wants they cater, and whose produce they carry down to Calcutta. To this industry is also due the construction and restoration of the roads which feed the river traffic. On the District Committees, who are responsible for the roads, the most active members have always been the planters; and they have supplied the greater part of the labour by which the work has been done. I shall return again to the problem of communications, which is one of capital importance in the Province.

Goalpara.

So far we have been dealing with the history and vicissitudes almost exclusively of the Assam Valley. A very few words will suffice to relate what there is to tell of the rest of the province. The district of Goalpara, as already mentioned, formed part of the Koch kingdom, a remnant of which is now represented by the small sub-Himalayan State of Koch, or Cooch, Bihar. It was retained by the Mughals when they abandoned Kamrup, and passed into the possession of the East India Company when they obtained the *Diwani* of Bengal in 1765. It was then part of the Bengal district of Rangpur, and its southern portion was included in the Permanent Settlement of 1793. The northern part, called the Eastern Duars, was annexed from Bhutan after the war of 1865-66. The Duars are inhabited by Meches, a division of the Bodo race, and consist largely of forest reserves containing valuable *Sal* timber. More than a quarter of the population of Goalpara are Mohammedans.

Sylhet.

Sylhet, that great and populous district to the south of the Assam Range, also came to us as an integral part of Bengal in 1765. The greater portion of it was conquered by the Mussulmans in 1384, whose spiritual leader was a certain Shah Jalal. The tomb of this saint still stands at Sylhet, and is much revered. A tract to the east, under the Khassi Hills, called Laur, remained independent for several centuries; but when the Mughals, in Akbar's time, became masters of Bengal, the Hindu Raja of Laur submitted to the Emperor. In Aurangzeb's reign, the Raja became a Mussulman, and moved out into the plain, building his capital at a place called Baniyachung, in the midst of the deeply flooded part of the district. Jaintia, a country covering nearly 600 square miles, and stretching from the neighbourhood of Sylhet town to the Cachar frontier, remained independent, under a ruler of Khassi lineage, until 1835, when, as already mentioned, it was confiscated in consequence of a human sacrifice performed by the Raja, who immolated three British subjects, kidnapped from the Nowgong district, on the northern side of the Jaintia hills, as victims to Káli at Jaintiapur.

The population of Sylhet is about two and a quarter millions, of whom more than a half are Mussulmans. The greater portion of the cultivated area of the district is permanently settled, and the Permanent Settlement of 1793 was here carried out in a manner which has no parallel in any other part of India, except in the not far distant district of Chittagong. Elsewhere in Bengal the settlement was made with the Chaudhris or Zamindars, who had been the persons responsible to the Government for the revenue of divisions of the district; from collectors of revenue, remunerated by a commission on collections, they were turned by the settlement into landed proprietors, while the ancient landowners, or ryots, became their tenants. Mr. John Willes, the Collector of Sylhet, however, resolved to settle the district with the actual cultivators, and to put aside the Chaudhris, who engaged only for their own home-farms. Whereas in the other districts of Bengal landed estates are numbered by tens or hundreds, in Sylhet they are numbered by tens of thousands. The actual number of permanently settled holdings at the end of 1901 was 49,847; of these only 469 paid revenue exceeding 100 rupees, and 21,621 paid under one rupee. In these minute estates the number of shareholders is often extremely great, and as joint responsibilty for the revenue prevails, any default on the part of a shareholder is liable to entail the sale of the estate unless the remaining sharers make good the deficiency. It may be imagined that the revenue records are of the most complicated character, and that the

business of collection is very tedious. As Mr. Willes's settlement was preceded by a survey, and only the estates covered by that survey were permanently settled, very large areas which were not at that time occupied fell outside the settlement. These areas remained the property of Government, and with few exceptions are now settled on temporary leases. Elsewhere in Bengal the permanent settlement covered the whole district, and no land remained at the disposal of Government.

A lively account of the condition of Sylhet after it was transferred to British rule is contained in the "Lives of the Lindsays," * the Collector of the time, in the last quarter of the 18th century, having been a member of that noble house. In those days "there was little silver or copper in circulation, and the circulating medium was carried on entirely in cowries, or small shells, such as are used in the African trade as ornaments for the women." The revenue of the district was 2½ lakhs of rupees, which was all paid in cowries, at the rate of 5,120 cowries to the rupee. "You may imagine, then," says Mr. Robert Lindsay, "how troublesome it was to manage this ponderous circulation when received as the revenue of the country. It required, in fact, very large cellars to contain them, and when finally collected for the year, a large fleet of boats to transport them to Dacca. This operation in all its details occasioned a loss of no less than ten per cent., exclusive of depredations on the passage down." In those days Collectors had many ways of making their fortunes which are not permitted now; and Mr. Lindsay cleverly contrived one which, while very profitable to himself, relieved the chiefs at Dacca of the vexatious business of dealing with a cargo of 1,280 millions of cowries. He entered into negotiations with the Khassi chiefs with a view to purchasing from them the limestone of their quarries, and gives a most amusing description of the Highlanders with whom he did business. He obtained the lease of the quarries, spent the cowries within the province in getting out and burning the stone, and realised cash from the sale of the lime which enabled him in the course of six months to obtain rupees for remittance to Dacca. And, as he says, "this branch of commerce soon became the foundation of my fortune."

Mr. Willes's permanent settlement of 1793 was made in cowries, the equivalent of Rs.3,24,150, and it is surprising to find that it was not till 1820 that payment in coin was introduced.

* See Vol. iii. pp. 163, *sqq.*

CACHAR.

Cachar was anciently the name of the kingdom comprising the valleys of the Dhansiri, Jamuna, and Kopili on the south bank of the Brahmaputra, and the district of Darrang on the north, peopled by the Bodo or Kachari race. It included the region of low hills which we now call North Cachar, but not the valley of the Surma or Barak, now the plains of Cachar, which was then a portion of the Tipperah State, where a kindred division of the Bodo race bears rule. The Ahoms in their progress down the Brahmaputra Valley drove the Cachar kings to leave their capital Dimapur on the Dhansiri, and establish themselves at Maibong in the centre of the hill tract; and about a century later they acquired the valley of the Barak as the dowry of a Tipperah princess. Some time after 1700 the Cachar kings were compelled by the aggressions of the Jaintia Raja to move into the plains, and took up their abode at Khaspur. The valley was already peopled to a large extent by a mixed population which had overflowed into it from Sylhet, and was by far the richest portion of their dominions. Here the rulers and their people gradually became Hinduised, and in 1790 the Raja Krishna Chandra and his brother, Govind Chandra, formally celebrated their adoption of the Hindu religion by entering the body of a copper image of a cow and emerging therefrom as Hindus and Kshatriyas. The hills they left behind are almost deserted, being, except the Lushai Hills, the most thinly peopled section of the Province; and Dimapur, till the advent of the new railway, was a solitude marked only by some fine tanks and very remarkable ruins, the sepulchral monuments of a line of forgotten kings.

At the beginning of the last century Cachar was in a state of anarchy. The Burmese had invaded and occupied Manipur, and the three princes of that country, Marjit, Chaurjit, and Gambhir Singh, who had been driven out by the Burmese, occupied Cachar, and set at naught the authority of the Raja. The three brothers were engaged in a struggle for supremacy with one another, and the Burmese, who were then in possession of Assam, threatened to follow them into Cachar. Burmese armies actually did enter the province both from Assam and Manipur; but the British Government, seeing the danger which threatened Sylhet, resolved to support Govind

Chandra, the Cachar Raja, and sent up a force which drove out the Burmese, and replaced Govind Chandra in power in March, 1824. A treaty was executed by which the Raja placed himself under British protection, and agreed to pay a tribute of Rs.10,000. In 1830, however, the Raja was assassinated, and as he left no heir, the country was annexed by proclamation in 1832.

Cachar now contains, in the plains portion, a population of 414,800, of whom about a third are Mohammedans. It is largely given up to tea cultivation, and in 1901 a quarter of the population were foreigners, either engaged on the construction of the railway or as tea coolies.

In 1874 all these districts were cut off from Bengal and constituted a new province under a Chief Commissioner, whose headquarters are at Shillong in the Khassi Hills, but who usually spends more than half the year in touring throughout his charge.

Climate.

The climate of Assam, both in the Brahmaputra and Surma valleys, is marked by extreme humidity. Dense fogs are characteristic of the cold weather, and rain, due to local condensation, begins early in the spring, about two months before the arrival of the monsoon, when, in the rest of India, the air is extremely dry. The mean temperature is low for a tropical country, and in the higher of the hill districts the climate is exceedingly pleasant throughout the year. The open parts of the Assam Valley, Sibsagar and Lakhimpur, are probably the tracts which, throughout the whole of India outside of the hills, are best suited for habitation by Europeans, who generally enjoy excellent health. Sylhet used also to be regarded as a very healthy district, in spite of its great water surface and the deep flooding which it undergoes in the rains; but of recent years, and especially since the great earthquake of 1897, a particularly malignant form of malarial fever has had the effect of greatly raising the mortality. Cachar is less healthy than Sylhet.

A fatal disease generally known as *kala azar* (properly *kala jwar*, or "black fever") has, for the last twenty years, been ravaging the districts of Lower and Central Assam, gradually making its way up the valley from the northern skirts of the Garo Hills, where it was first noticed in 1882, and invading in succession Goalpara, Kamrup, Nowgong, and the parts of Darrang studded with outlying hills of the Assam range. Its effect upon the population in these districts has been most deplorable. "Tracts which, before its advent, were covered with thickly-peopled and prosperous villages, have been left by it deserted and uncultivated. Whole villages have thus disappeared, and large areas of land have been thrown out of cultivation." Between 1881 and 1891 the population of Kamrup decreased by 1·6 per cent., and during the next ten years by 7·1 per cent., while in the neighbouring district of Nowgong there has been a loss since 1891 of no less than one-fourth of the population.

I need not say that everything that seemed likely to be effectual has been tried by Government to stop this terrible scourge. Dispensaries have been established along its line of advance; medical men have been sent to itinerate in the villages, and quinine has been largely and freely distributed; on two occasions special inquiries have been made into the origin of the disease and the means of combating it. But in spite of all it has steadily advanced, with the results I have related. It is now reported that its progress further eastwards appears to have been checked, and that it is dying out in Kamrup and Nowgong. The one consolatory element in its history is furnished by the census statistics of the Garo Hills, where, between 1880 and 1891, it caused great mortality. The population of that district, which is now free from the disease, increased by 13·7 per cent. between 1891 and 1901; and it seems reasonable to hope that a similar recovery may set in elsewhere to replace the losses which have been suffered.

During the last ten years Assam has certainly been much more unhealthy than in any previous period for which approximately accurate statistics are forthcoming. Besides *kala azar*, cholera and ordinary malarial fever have been widely prevalent; and the great disturbance of the earthquake of June, 1897, was followed by extensive sickness and mortality, both in the hills and in the plains of the Surma Valley and Central and Lower Assam. Of late, however, there are signs of the setting in of a healthy cycle.

Administrative Problems.

The problems of administration in Assam differ greatly from those which meet us in the more thickly populated parts of India. Questions of rent, and the relations of landlord and tenant, which offer so much difficulty elsewhere, have hardly any importance in a country where

land can be had for the asking, and nearly all the cultivators hold directly from the State. Agricultural indebtedness, and the relations of moneylenders to the landed classes, do not yet call for any special treatment. Serious crime is practically absent, and there are no criminal classes. Famine due to failure of rain is unknown. All those difficulties which elsewhere spring out of the pressure of population on the soil are here non-existent. There is no such pressure, except in a portion of the west of Sylhet, and there is a ready outlet for expansion in the waste lands to the south of that district, and in the neighbouring district of Cachar.

Our problems are, in fact, of the opposite kind. They arise from the extreme thinness of the population and the excessive abundance of waste land. The people are almost exclusively agricultural; there is scarcely any indigenous labour in the province, and consequently all the help needed for its exploitation —for the great tea industry, for the working of its coal mines and oil springs, for the works of communication, roads and railways—has to be imported. The large proportion of the population which is thus not engaged in the production of food renders the position of the cultivators, who dispose to them of their surplus grain at very high prices, compared with those current in the rest of India, most comfortable. In fact, the Brahmaputra Valley cannot yet feed itself, and grain has to be imported from Bengal. In these circumstances it is evident that the first necessity of the Province is to get better peopled. Until labour is available its great natural resources cannot be developed, and the requirements of a civilised and progressive society cannot be supplied.

Immigration.

The great agency through which immigration and colonisation is effected is, in the Brahmaputra Valley, the tea industry. In the Surma Valley the indigenous population is already filling up blank spaces with ordinary cultivation, though there also, especially in the south, there are large tracts where tea gardens play the same part as in Assam proper. Experience hitherto has decided against any measures of direct management of colonisation by Government. Nowhere in India have such measures been successful, except in tracts like the land in the Punjab and Sind rendered available by the new canals, where the return from the area thrown open to cultivation was immediate, and the cultivators ready to take it up were to be found in the settled tracts adjacent. In Assam a climate unfavourable to the new arrival, a diet to which, if he comes from northern India, he is unaccustomed, and a population alien in habits, race and speech, all contribute to deter the independent settler. It is only acclimatised colonists, who have passed their novitiate as labourers in tea gardens, and had their wants at the outset provided for there, who are found to thrive. The latest returns show that 97,000 acres are now held direct from Government by time-expired tea coolies, while many more hold land for cultivation from the gardens where they are employed, or as sub-tenants of other landholders.

Development of Communications.

For colonisation, therefore, one must look mainly to the development of the tea industry and the opening out of the Province by improved communications. And in the latter respect the progress, since I first knew Assam in 1880, has been immense. In those days the only way of travelling from Calcutta to Dibrugarh, after leaving the railway at Goalundo, was by means of large and heavy steamers, each towing a pair of flats, which proceeded slowly up the river, often taking a month to make the journey. It was literally easier, and took a shorter time, to get from England to Calcutta, than from Calcutta to reach Upper Assam. In the Surma Valley these steamers could get only half way up the valley in the cold weather, and the rest of the journey to Silchar had to be done by small country boats. In 1881, however, the energy and perseverance of the late Mr. Archibald Campbell, Deputy-Commissioner of Dhubri, led to the establishment of a daily service of quick, powerful, small steamers, doing the journey upwards from Dhubri to Dibrugarh in four days. Later, a similar service was established between Goalundo and the Surma valley. This was an immense convenience to travellers, and greatly diminished the dread felt by immigrants of the long and tedious river journey to which they used to be subjected, and on which severe outbreaks of cholera often led to deplorable mortality among them. The river will, it may be expected, continue to be the great highway for a large part of Upper Assam, but in a year's time, when the Assam-Bengal Railway, which has been under construction since 1891, is opened throughout its entire length, an enormous addition to the facilities of communication will have been provided, and there is

every reason to hope that the flow of immigrants into the Province will proceed with increased rapidity. This great work, including its branches, is 779½ miles long from Chittagong to its junction with the Dibrugarh-Sadiya railway at Tinsukia. Of this length 644 miles are already open for traffic, and the whole of the Surma Valley has now direct access to the sea, while a working line stretches from Gauhati for 265 miles towards Dibrugarh. The latter section runs for a great part of the way through a very thinly peopled and at present very unhealthy country, where *kala azar* has wrought its worst ravages; the valley of the Dhansiri, from Lumding to Golaghat, is practically uninhabited, and these tracts cannot be expected to afford any local traffic to the railway for a long time to come. Nor can any such traffic be anticipated from the North Cachar hill section, the difficulties of which are still preventing the establishment of through communication between the south and north of the province. But if the line does not promise to be a paying concern for several years at least, it will certainly be an artery of traffic of the greatest economic importance to Upper Assam, besides securing the strategic position in the Naga Hills and Manipur. Had such a railway existed in 1879 or 1891, the Naga war in the former year and the Manipur troubles in the latter would have been speedily disposed of, and would have entailed much less cost in life and treasure than was actually the case.

Excise.

There are, of course, the ordinary administrative needs to be provided for in Assam. Land revenue has to be assessed and collected, police, and courts civil and criminal, to be maintained, hospitals and prisons to be provided, education to be furthered, forests to be protected and worked, and local government to be fostered. One of the most important departments in Assam is that of excise, dealing on the one hand with liquor, on the other with opium and drugs. The revenue from this source in 1901-2 was Rs.28,33,034, or nearly half the revenue from land; of this, Rs.17,11,000 was derived from opium, Rs.4,00,000 from hemp drugs, and Rs.7,22,000 from spirits. These large figures offer a ready target for criticism, and it may be well to give some account of the system. Until 1860 opium was grown everywhere in the Assam Valley, and the population were notoriously addicted to its use. This state of things was not due to British rule, for it was in existence already when that commenced. In the year mentioned the cultivation of opium in Assam was prohibited, and the quantities of the drug required by the people have ever since been supplied from the Government stores in Bengal. Year by year the price at which this opium has been issued to the dealers has been enhanced, and it is now Rs.37 a seer; and the cost to the retail purchaser is further increased by the license fee, which has to be paid by the farmers of the monopoly in the area leased. The result is that opium in Assam costs the consumer more than it does in any other part of India, and the annual decrease in the amount issued for consumption has been steady and is very striking on a comparison of a series of years.* Further than this it is not possible to go. Opium is grown by the hill tribes across the border, and can, owing to its small bulk, easily be smuggled in among other merchandise by the trading classes, who come from a country, Rajputana, where its use is universal. It cannot, therefore, even if this were justifiable, be kept out altogether, and, since that is impossible, the only reasonable and proper course is to check its use by making it as dear as we can. The case in regard to hemp drugs is of the same kind. Hemp grows wild in every part of the Province, but may not be cultivated. The wild hemp, moreover, contains much less of the intoxicating resin than the cultivated plant, which is grown under Government control in Rajshahi in Bengal. All the *ganja* used in Assam is imported from this source, and charged as high a duty as it will bear without driving the consumers to the use of the illicit article.

As regards spirits and fermented liquor, the aboriginal and immigrant races in Assam have always been accustomed to consume them freely. Nothing could be further from the truth than to suppose that their use is due to the influence of British rule. The materials for both are everywhere at hand, for both are

* Consumption of Opium in Assam for Twenty Years.

	Maunds.		Maunds.
1882-83 ...	1,736	1892-93 ...	1,334
1883-84 ...	1,404	1893-94 ...	1,385
1884-85 ...	1,482	1894-95 ...	1,377
1885-86 ...	1,446	1895-96 ...	1,378
1886-87 ...	1,447	1896-97 ...	1,331
1887-88 ...	1,417	1897-98 ...	1,332
1888-89 ...	1,411	1898-99 ...	1,342
1889-90 ...	1,495	1899-1900 ...	1,301
1890-91 ...	1,308	1900-01 ...	1,291
1891-92 ...	1,369	1901-02 ...	1,205

made from rice. If they were not supplied by the agency of licensed dealers, they would be made by the people themselves in their houses, as they actually are in the thinly peopled hill tracts by the aborigines. In such a country, where the neighbouring jungle affords ample cover, and where the ancestral habits of the people interest them all in defeating any attempt at repression, it would obviously be impossible to stop the consumption of liquor; and the only alternative is to bring it under control by establishing licensed shops where it may be made and sold, the holders of which will be interested in bringing to light illicit manufacture. This is the plan adopted, and the monopoly thus accorded has resulted in the price of spirits being raised to a level which is, proportionately to strength, nearly as high as that at which they are sold in this country.

Labour Questions.

The special problems of administration peculiar to the Province are, in the first place, the supervision of the relations between the tea planters and their *employés*, and in the second, the keeping of the peace among the hill tribes who enclose on all sides but one the settled and cultivated area, and who would otherwise be again, as they were before, a standing menace to civilisation. It is difficult for one who has not had experience of the situation to realise how much of the time of the district staff in the tea districts is taken up with the inspection of tea gardens and the settlement of labour questions. There are 820 gardens in the province, divided (except a few small estates) between six out of the eight plains districts. Each of these has to be thoroughly inspected at least once a year, and frequently more than once. Contracts have to be verified, disputes as to tasks and wages settled, complaints heard, returns checked and compiled, and a close supervision constantly maintained over the housing and treatment of a body of labourers who, in 1901, amounted to 657,331, employed in cultivating 338,000 acres under tea.

Relations with Hill Tribes.

The story of our relations with the hill tribes is long and complicated. Along the skirts of the Himalaya the races with whom we have to deal lie outside British territory; elsewhere they are under direct control, and are managed from within the tracts where they live. In the first class, beginning from the west, there are first the Bhutias of Bhutan, than the Tibetans of Towang, then certain independent Bhutia chiefs, then the Akas, then the Daflas, then the Miris, next the Abors, and, lastly, the Mishmis. With every one of these peoples, except the Towang Tibetans and the Miris, we have at one time or other had hostilities caused by their raids in the plains. We fought the Bhutanese in 1864-65, the Akas in 1883-84, the Daflas in 1873-74, the Abors on several different occasions from 1858 to 1894, and the Mishmis in 1855 and again in 1899. Under the native Government these hillmen, except the Mishmis, had assignments of revenue or tribute from the adjacent plains, and on our succeeding to the sovereignty we found it expedient to continue these payments as a means of securing good behaviour. The allowances are generally laid down in treaties, they are small in amount, and are very useful in enabling pressure to be exerted in any case of misconduct, and information to be obtained as to what is going on beyond the border when the hillmen appear to claim them.

The tribes included within the Province, also beginning from the west, are the Garos, the Khassis, the Kacharis and others of North Cachar, a large number of different tribes collectively known as Nagas, and the Singphos or Kachins, who lie on either side of the Patkoi, between Assam and Upper Burma. To the east of the Surma Valley there is the State of Manipur, controlling a multifarious collection of tribes divided between Nagas and Kukis; and south of Cachar there is the immense region of forest-clad hills inhabited by the Lushai Kukis. With few exceptions these tribes when we first came in contact with them followed the practice of head-hunting. Even the Khassis, who for several generations have been a comparatively civilised and progressive people, were, in the 18th century, a terror to Sylhet, and I have been told by men of that race still living that they had heard from their fathers of the heads of Bengalis being exposed on the table stones dedicated to the tribal goddess at Cherrapunji. This taste for the collection of heads, when it was gratified at the expense of our subjects, had to be put down, and at different times we have been compelled to take one measure after another to bring the tribes under control. It would be tedious to describe these operations in detail. They have involved from first to last much desultory warfare, and the loss of many valuable lives. The Indian Government has generally shown the greatest reluctance to advance into the hills and assume the responsibility and the

hankless task of directly administering the avages who inhabited them ; but experience as by degrees shown that this is the only ffectual method to adopt, and that an nforced peace is eventually welcomed by he tribes themselves. The successful administration of these wild races, interesting n their primitive barbarism, and many of hem capable of great progress if firmly ınd sympathetically dealt with, furnishes some of the brightest pages in the history of Assam. The work of David Scott among he Khassis, of Williamson, the civiliser of the Garos, of Butler and McCabe, the organisers of good government among the Nagas, of MacCulloch, Johnstone, and Maxwell, advisers and administrators of the State of Manipur, will always be remembered with pride within the Province, and well deserves to be better known outside of it. But though the peace has been kept, and secular needs provided for, by British administrators, it should not be forgotten that in some of these areas the most important work in educating the hill races and advancing them in the scale of civilisation has been done by missionaries. In the Khassi Hills the results have been most remarkable. The Welsh missionaries, during the sixty years of their activity, have provided the people with an alphabet, a literature, and schools which have been so successful that the district stands second in the Province in point of literacy among males, and very much at the head in literacy among females and on the total population. Excellent work of the same kind has been done by the American Baptists among the Garos, a duller race than the Khassis; and the same agency has commenced work in the Naga and Lushai Hills with every prospect of success. As in other parts of India, the non-Aryan races whose religion is animism have shown themselves most responsive to Christianity, and it is among them that the greatest success has been attained in conversions.

[During the reading of the paper the chair was vacated by Lord George Hamilton, and taken for the remainder of the proceedings by Sir Dennis Fitzpatrick, K.C.S.I.].

DISCUSSION.

Sir DENNIS FITZPATRICK, in opening the discussion, said that the present was the second occasion upon which Assam had been honoured at a meeting of the Society. On a previous occasion a most interesting paper was read by Mr. Luttman-Johnson on the terrible earthquake which created such havoc in Assam, and killed a most distinguished British officer, Mr. McCabe, Sir Henry Cotton also narrowly escaping. Sir Charles Lyall's paper took a wider scope, and contained much that was of great interest. In 1887, when he (Sir Dennis Fitzpatrick) was appointed Chief Commissioner of Assam, he felt some diffidence in taking charge of a province so very different from any other province in India, and one which presented such immense diversities, both in the aspects of Nature and in the ways of men. Fortunately when he arrived in Assam, he found that he had as his chief coadjutor, and his principal guide, philosopher, and friend, the author, a man of omnivorous tastes, and taking all knowledge for his province. He had always been most grateful to Sir Charles for the advice and guideance he gave him at that difficult time. His only regre- was that he was not always able to keep up with him. The author had mentioned the great Japvo Peak, in the Naga Hills. When they were in camp together, the author went right to the top of that hill, 10,000 ft., but personally he (Sir Dennis Fitzpatrick) was unable to do so. There were other heights, too, of a different kind to which he was unable to follow suit. There was a great deal in this very paper, especially in the historical, ethnological, and scientific parts, upon which he was unable to give an opinion; but there were others present eminently competent to do so.

Mr. LUTTMAN-JOHNSON expressed the thanks, not only of the audience, but of all those who had visited the province of Assam, to the author for his interesting paper. Everybody who had served or had lived in Assam must have been struck with the faithfulness of the descriptions given by Sir Charles Lyall. While listening to the paper the old province seemed to rise up before him, and old memories were renewed. What had impressed him most in the paper was the heterogeneousness of the province, the astounding variety of peoples, of languages, and of civilisation. He did not know exactly how many languages there were in Assam, but there must be hundreds. It was absolutely impossible to make any general statement about Assam, except that it was very damp. There were peoples in the country in all grades of development, social and material, ranging from the more or less civilised Bengali population of Sylhet, right away down to people in the Naga Hills, who wore absolutely no clothing. It was quite impossible for any Chief Commissioner of Assam to have a policy. He might have a policy with reference to one set of the people or another, but generally he was there to govern and make arrangements for all the different phases of civilisation, each on its own merits. It was quite impossible for him to view the province as a whole. No one would have started out to weld such heterogeneous materials into a province. The truth was the province was not originated for the good of the people or the province. It was discovered in 1871 that the Lieut.-

Governor of Bengal ruled over nearly 70 million people, and it was decided that he ought to be relieved of some part of his duty. Many suggestions were made, and it was at length arranged to cut off out-of-the-way parts which gave him a great deal of anxiety. The author had mentioned the history, geography, and ethnology of the country, but had not given much account of what the province, which was now 30 years old, had achieved, what advantages the new administration had brought. He might at least have mentioned that the province had escaped the Bengal Board of Revenue. The district of Gulpara was not, as the author stated, included in the permanent settlement in 1793. Thirty years later the Board of Revenue decided not to resettle it. Similarly, a few years later the Board offered the permanent settlement of the district of Cachar to a Bengal indigo planter. The revenue administration of the Sunderbund in Bengal under this Board was disastrous. But the advantage of the change were not wholly negative. A photograph had been shown of a native commander of a steamer. Formerly it was thought that steamers were required to have a European commander and engineer, which cost an enormous amount of money, and it was impossible to run steamers cheaply. In 1881 small daily steamers of 120 tons to run up and down the river were started on the basis that the subordinate officers of the big steamers should be developed into commanders, and the subordinate engineers into engineers. That was an immense success, and now all the rivers of Bengal were covered with steamers carrying passengers, whose commanders and engineers were natives. That was perhaps the greatest achievement of the province of Assam. The author had stated, and he agreed with him, that the development of the province depended entirely on the tea industry. Sir Charles Lyall further stated that there were now some 700,000 people who were born in other provinces in the country, who, together with the descendants, made a total of perhaps one million inhabitants brought into the country by the aid of the tea industry. It was obvious to all that the chief thing to be done by the rulers of the province was to bring the land under cultivation. In Assam proper there must be something like six to eight million acres which could be brought under cultivation and support a population of one to the acre, say 6,000,000 people. The result of the 30 years' working of the province was that only 750,000 people were working at the tea gardens, and another 250,000, or perhaps 500,000 settled in the country. The author mentioned a very important fact, namely, that only 97,000 acres outside of tea gardens were supposed to be cultivated by the immigrants. That as a result of 30 years of government was not a good result. With the help of the tea industry a very much larger area ought to have been brought under cultivation. The Government could not risk importing population from one part of India to another, because for the first two or three years, before the people were acclimatised, they had to be nursed. In Assam there were at their disposal a corps of excellent nurses. Every tea planter in Assam might have been employed by the Government to nurse the immigrants until they became acclimatised. All that had to be done was to make some arrangement with them that after immigrants had served their time in the tea gardens—the nurseries—they were to be settled on the soil. Every one of the immigrants would have been worth something like 3 rupees a year to the Government. By helping to persuade people to immigrate, or by offering to give land to the coolies when they had served their time in the gardens, or by paying part of the cost of the immigration, or some scheme of that kind, more than 97,000 acres might have been brought under cultivation in the course of 30 years. The author might have told them how the cost of the province was nearly double what it was under the Government of Bengal. How expecially the consumption of stationery—that is, ink-slinging—had increased by leaps and bounds. He might have told them how the number of shops for sale of opium have been reduced about to one-half. He (the speaker) would have liked to mention other achievements of the new provincial administration, but time was short.

Sir Henry Cotton, K.C.S.I., after thanking the author for his interesting paper, said he thought the great requirement of the province of Assam was the provision of capital, labour, and people for its expansion and development. There were more than six million acres of culturable land uncultivated simply because there were no people to cultivate them. Mr. Luttman-Johnson and the author conceived that the tea industry would ultimately cultivate those lands. That was a mistake. The tea industry imported labour into the province, not for the benefit of other people, or for the benefit of the Government, but merely in its own interest and for its own profit. It would be a great misfortune if the Government were ever to depend upon the tea industry for bringing the waste lands under cultivation. It would be most unwise if the Government were ever to put pressure on tea planters, or adopt any policy which might be understood as putting pressure on them in that direction. The tea planters required all the labour they could get for their tea gardens. Every year they had to import new coolies from Bengal, and was it to be supposed that any tea planter in the province would willingly allow his labourers to leave the gardens and take up rice or jute cultivation? Never! It was not to the tea gardens that they could look for the expansion of cultivation and the colonisation of the province; some other scheme must be devised which would not injure the tea industry. When he was in the province he prepared an elaborate scheme for colonising the country, in which he was assisted by Sir Patrick Playfair and other gentlemen who were present. Unfortunately those proposals,

which involved a zemindari settlement of the waste areas, did not receive the support of the Government of India, but they still had the field. The province would never be colonised or the waste lands brought under cultivation until the Government took into consideration special remedies for the purpose. There was another thing the province needed, and that was better communications, not so much new railways, but feeder lines which would connect all parts of the province with the great channels of communication, river as well as railway. The province owed an enormous debt to the river steamship companies, which had done so much for it, and he regretted that more encouragement was not given to them by the Government. The Government was pledged to its railway system, on which it had embarked enormous sums of capital, thrown away millions of pounds on a mistaken alignment. That led the Government to encourage and foster the railway system at the expense of the river system. The steamship companies were suffering very much from the competition of the railways, and receiving very little encouragement. Many of the feeder lines should be connected with the great rivers, the Brahmaputra and the rivers of Sylhet. It was impossible to have good permanent roads all the year round in a province where the rainfall exceeded 100 inches in the year, the greater part of which fell in three months; it was impossible to have metal roads because the expense was absolutely prohibitive. It was only possible to have small, light tramways of 2 feet gauge, which would tap the tea gardens and the large populous places, connecting them with the rivers and any part of the province where the Assam and Bengal Railway had been laid down. He regretted that his proposals in that direction had also failed, because the Government of India would not come forward and offer a guarantee of any sort on the capital which might be raised. Capitalists naturally hesitated to invest their capital in the tramways when they saw that the main railway line had involved the Government in such enormous expense, although the Government had guaranteed that line. He did not suppose the feeder lines would have brought in large profits, but they would have paid their way and yielded a dividend of 4 or 5 per cent. He still hoped that his successors in the province would take up and more successfully accomplish the improvement of communications.

Mr. T. DURANT BEIGHTON said the author alluded in his paper as a matter of certainty to the identity of the Tsanpro with the Brahmaputra, and he was still more surprised to see in the map which had been unfolded the two names given as an alternative. He happened to be in possession of the very latest information on that point. He saw Dr. Scott Keltie, of the Royal Geographical Society, that morning and discussed with him and the librarian what the precise facts were in regard to the identity of the two rivers. It turned out that there were still 80 miles absolutely unexplored, and the reason of this non-exploration was supposed to be the existence of certain savage and warlike tribes. A great deal had been heard of such tribes, but he confessed he could not understand why the Government hesitated to send through that absolutely unkown region a company of Ghurkas with explorers. This force would be sufficient to guarantee the explorers' safe conduct, and the identity of the two rivers, one of the greatest and most important geographical problems at present existing, would be solved. One point had been ascertained by Prince Henry of Orleans, namely, that the old idea of the possible identity of the Tsanpro with the Irrawaddy was unfounded. Sir Charles Lyall had referred to the Forest Department. Half of the whole of the area of Assam was devoted to forest, but out of the 10,000 square miles under the nominal control of the Government only 3,000 were reserved or protected, and the remainder described as "unclassed," *i.e.*, no survey had taken place, and they could not be utilised for the purposes of selling timber, nor could leases be granted. On looking at the report of the Forest Department for last year, he found that it made an enormous profit—86 lacs o rupees for the whole of India—and that of all the undertakings of the Government of India that was the one which apparently yielded the greatest commercial success. Supposing the Government of India had the monopoly of the teak trade, no doubt the policy adopted would be in the interests of the people of India. But there was formidable competition with Siam and Java. Although the timber of those countries was not so good as that grown in Burmah, Java and Siam had better water carriage and greater facilities for disposing of the material. Would it not appear to a man conducting a mercantile business, on ordinary commercial principles, that it would be advisable for Government, who had the entire forests under their control, to crush out that competition by charging a lower price? He would like to see the staff of the Forest Department doubled, and the survey work doubled. There was enormous profit in store as soon as the forests were properly developed. Pressure ought to be brought to bear by the Government in those places where famine was liable to occur to induce immigration to Assam. He regretted that Sir Henry Cotton had not enlightened the meeting with details of the scheme he had formulated for colonising Assam from the more densely populated regions.

On the motion of Sir DENNIS FITZGERALD, a hearty vote of thanks was accorded to Sir Charles Lyall for his admirable paper, and the meeting terminated.

Sir W. E. WARD, K.C.S.I., writes:—Having been present at the meeting of the Society held on the 14th instant, and listened with the greatest interest to the admirable paper on Assam, read by Sir Charles Lyall, I should like to make one or two remarks

which, I think, are relevant to that paper and to the short discussion which followed upon it. No one who has lived for any length of time in Assam, and who, like myself, has given the greater portion of his thirty-five years of official life in India to that province, and to work having for its object the furtherance of the progress of its people and its industries, can fail to take a keen interest in a paper which, among other things, placed before those who were privileged to hear it read, a clear, succinct, and lucid statement of facts, showing what that progress has been up to date. I am afraid I must admit that I was rather shocked at what I understood to be the purport of Mr. Luttman-Johnson's remarks, to the effect that Assam had in no way profited from its separation from Bengal in 1874. Such a statement, if seriously meant, seems to me rather to reflect on the work done by past Chief Commissioners, who, whether their efforts towards progress are now, by their results, to be judged favourably or unfavourably, can at least, I think, claim credit for having given time and personal attention to the needs of the province, as well as a money expenditure devoted to material improvements therein, which certainly the Bengal Government never did give it, nor do, I think, ever would have given it, had Assam continued to the present day to form an integral portion of Bengal. In saying this, I am casting no reflection on the many able administrators who ruled in Bengal prior to 1874; it is sufficient to state that it was absolutely impossible for any administrator, however able, having regard to the state of communications between Bengal and Assam a quarter of a century ago, to make himself personally acquainted with the needs and requirements of the distant districts lying on the North-Eastern frontier; and it was this absence of all personal knowledge of facts connected with these districts, that was the main cause of their being neglected in comparison with districts nearer to head-quarters, and more in the line of the Lieutenant-Governor's tours of inspection. It would not be difficult for me to indicate what important measures have been completed, or set on foot, by successive Chief Commissioners, which I am confident would never have seen the light had the districts now comprising the Province of Assam continued to the present day part of Bengal. In short, the distance from head-quarters of these districts, and their inaccessibility, were mainly responsible for their comparative neglect under Bengal administration; and this consideration, it is well known, was the chief cause of the separation from that province in 1874 of the Brahmaputra Valley, Cachar, and Hill districts, and subsequently of the district of Sylhet, with the result, I venture to think, that progress in all departments of administration affecting those districts has been far more rapid than would ever have been effected under Bengal rule. I trust that the time is not far distant when Bengal will yield up to Assam some other of its districts, and notably the district of Chittagong, the transfer of which was strongly advocated by me when I left the province in 1896. But the point which I wish particularly to emphasis in these remarks is that it cannot be too strongl insisted upon that the main factor in the progress o Assam has been, and in my opinion always will be the prosperity and progress of the tea industry Anything, therefore, which materially hampers th progress of that great industry, must be recognised a a spoke in the wheel of progress of the provinc generally. Unnecessary legislation, in which I woul include unnecessary and excessive taxation, is, there fore, to be deprecated. I have no desire to ent into the controversy which we have recently seen i the *Times* between Sir Henry Cotton and the speci correspondent of that paper; but I feel bound to sa that I do not take the desponding view Sir H. Cotto did in that correspondence of the general conditio of the imported tea labourer, or of the general rela tions subsisting between him and the tea plante After 20 years' experience of the province of Assam during eight of which I had the privilege of being it Chief Commissioner, and in the course of which I hav travelled, I should think, over every road in th province, and visited a large majority of the garden I think I can say that I always have been fully cog nisant of the fact that, here and there, abuses exis here and there the coolie is underpaid and perhap underfed, here and there he does not get his statuto wage. I have, nevertheless, always set my fac most strongly against generalising from particul in-tances, and setting the law in motion again the whole body of the employers of tea labo owing to the sins of the few. In this view have regarded with disfavour the recent amend ment of the Assam Emigration Act, as it stood i my time, so far as that amendment has provided fo increasing the coolies' wage, because I do not think th sufficient grounds were forthcoming for altering th then existing law on this point. So, also, in depreca ing unnecessary taxation on the tea industry, I refer, o course, to the heavy import duty of 6d. a lb. impose in this conntry. Granting the extra 2d. per lb. wa necessary as a contribution to the war, the mainte nance of this extra charge now the war is over, seem to me quite unjustifiable, more especially so in th present depressed state of the tea industry. N doubt that state has been largely brought about b excessive production of late years; but that is n reason why Government should step in at th inopportune time, and make matters worse by legisla tion, the effect of which has been to increase materiall the expenses of a tea-garden, and at the same time t maintain a heavy tax on its produce. It remains t consider, if the material progress of Assam is s largely dependent on the prosperity of the tea industry what can be done to further the progress of tha industry. Sir H. Cotton has very truly said that w cannot look to the tea industry alone to produc within a reasonable period a sufficient population wh will settle down as cultivators in the Brahmaputr valley and take up the vast areas of fertile land ther lying waste. He, therefore, strongly advocates hi

lonisation scheme; but I have never felt that the overnment need be in any great hurry to get all the ıltivable waste land of Assam brought under cultivation, and I am certainly strongly opposed to any heme of colonisation through the instrumentality of engali zemindars, for I take it that no Bengali emindar, or any other person, would undertake to ring colonists into the country to cultivate it s his tenants unless the Government of India was repared to make him practically a present of the land e undertook to colonise; and why the Government hould make anyone a present of what will certainly, ı the not very distant future, when communications re improved, prove a very valuable asset, although t present there may not be much demand for the ınd, I am not quite able to see. But Sir H. Cotton urther went on to deal with the question of communications in Assam, and with his remarks on this ubject I am in entire accord, though I should like o amplify somewhat what he said; for it is here that we come to what, in my opinion, is by far the most mportant factor that will operate in the future in dvancing the province generally, both indirectly hrough the great tea industry, and directly by promoting free immigration from Bengal—not only immigration in search of labour on the tea gardens, but mmigration also for the purpose of settling on, and taking up, land for ordinary cultivation—and that factor is the improvement of communications. I refer, however, here not only to the internal communications of the province, as Sir H. Cotton did, but also, as being still more important, to the main communications between Bengal and Assam, to which the internal communications would necessary be subsidiary. We know that, since Assam became a separate province in 1874, a very great advance has been made both in its external and internal communications. The chief advance has been hitherto in the river services. Fifty years ago there were no steamers on the Brahmaputra or Surma Rivers, and the journey from Goalundo to Dibrugarh, in boats, took two months at least, and from Gauhati to Dibrugarh one month. Then came an exceedingly slow steamer service from Goalundo to Dibrugarh which was running when the first Chief Commissioner was appointed in 1874. By this service a journey from Goalundo to Dibrugarh lasted about three weeks. In 1883, Sir Charles Elliott started the scheme of small quick despatch steamers, which has been an immense success and an immense boon to the tea industry and to the province generally. Following on his lines I was able to see a similar service started in the Surma Valley. By these steamers, passengers, including imported and free immigrants, can now cover any given distance in less than half the time the old steamers could. A large scheme also of internal road communications was planned by Sir Charles Elliott, which, n the course of my eight years' incumbency, I was able to see very nearly completed. These road communications were, however, at their best, only cold weather roads raised at great cost above flood level and quite unfit, as Sir H. Cotton has pointed out, for any heavy cart communication in the rains, while the cost of metalling them was, and always will be, prohibitive. They form, however, for the most part, excellent foundations for a system of tram lines throughout the province, if only the Government of India can be induced to give a well-considered scheme of such lines its favourable support. Lastly, there is the great Bengal Assam Railway, soon approaching completion, which beyond all question will contribute largely to the future development and prosperity of the tea industry and of the province generally; and there is the Dibrugarh-Sadiya-Makum Railway (also started in Sir Charles Elliott's time) which has done wonders in promoting the great coal industry at Makum, as well as in opening out the country to cultivation all along the line. But, notwithstanding all that has been done in recent years to improve the external and internal communications of the province, the work accomplished has not yet sufficed to produce any marked increase in what we especially wish to see, namely, free immigration from the congested districts of Bengal either to the tea gardens, or to the waste cultivable lands of the Brahmaputra Valley. The would-be free immigrant is still deterred from undertaking a long and weary journey to a distant and to him unknown land, involving a confinement of at least four or five days on board a river steamer, with all its attendant worries and discomforts, to say nothing of the prospect of sudden death from cholera, a disease which so frequently breaks out on these vessels in spite of all precautions taken to ward it off. The remedy, therefore, that I consider still remains to be applied is the connection by rail of the Brahmaputra Valley with the Bengal railway system, a remedy strongly advocated by me 20 years ago, when the alignment of the Bengal-Assam railway, as proposed by the Chief Engineer of Government, was under discussion. I am glad to see that the sanction of the Secretary of State for India has recently been given to the construction of this connecting link, which I venture to think, when completed, will, coupled as it then will be with the completion of the Assam-Bengal system, supply the one thing that has been wanted all these years to induce free immigration from Bengal into the Brahmaputra Valley, and to reduce—as I have no doubt it will reduce by fully 50 per cent.—the present enormous cost of importing labour to the tea gardens of that valley. By this connection not only will the tea industry largely benefit; the province generally will benefit apart from any consideration for that industry. The time also will probably then have arrived for considering the propriety of repealing altogether the Emigration Act, the maintenance of which in the Brahmaputra Valley is now so essential in the interests, not only of the employer, but also of the immigrant tea labourer, and of leaving the flow of labour to the tea gardens from the congested districts of Bengal to be regulated by the ordinary laws of supply and demand; for the causes

which now operate to prevent the would-be emigrant to Assam from voluntarily setting out on a long, troublesome and risky journey will then have been for the most part removed. The railway now no longer inspires fear in the mind of even the simplest and most uneducated native, who would seldom, in these days, hesitate to take by this mode of transit the longest journeys in point of time that would be required of him to reach any part of Assam he might desire to go to, either in search of labour on the tea gardens, or to take up land for ordinary cultivation. In thus laying stress upon the importance of linking up the Bramahputra Valley by rail with the railway system of Bengal and Upper India, it must not be understood that I do not attach the importance that Sir H. Cotton does to improving the internal communications of the province by a well-considered scheme cf tramways. Many of the existing high-embanked roads of the province were, as I have stated, specially constructed by Sir Charles Elliott and myself as foundations for the carrying out of such a scheme; but everything cannot be done in a day; where funds are limited, one must carry out works in the order of their importance, and in my view the most important work to be now undertaken, next to the completion of the Assam-Bengal Railway, is the railway link with Bengal to which I have referred. I gather from Sir H. Cotton's remarks that the Government of India has not regarded his tramway schemes with favour. With the details of these schemes I am only imperfectly acquainted; but if, as I understand, they demand a three per cent. guarantee from the Government of India, the reluctance of the Government to sanction them in their entirety may perhaps be appreciated, having regard to the very large expenditure which it has already incurred, and will still have to incur before the Assam-Bengal railway, and its connection with the Bengal Railway system has been completed. A good deal, however, might perhaps be done in furtherance of Sir H. Cotton's schemes, if the Government of India would only agree to sanction the grant of free land for the proposed lines, as well as free timber for first construction. These two conditions were always strongly pressed by me in my time on the attention of the Government of India, but, owing to the exacting demands of the Forest Department, the grant of free timber was refused. I think that, if a little more generosity had been shown by the Government of India in the direction I have indicated, the internal communications of Assam would have advanced to a point considerably beyond that to which I understand they have advanced since I left the province more than seven years ago. In conclusion, let me note that progress in prosperity—progress in the extension of cultivation in the Brahmaputra Valley—is not to be looked for solely from the Assamese. In the Surma Valley this progress is marked, because the cultivator there cultivates, not only for home consumption, but for export. In the Brahmaputra Valley the cultivato[r] cultivates solely for home consumption. Herein lie[s] the essential difference between him and the Burman who, by the way, it may be stated, lives unde[r] conditions of climate and soil, and of land tenur[e] and settlement, very similar to those obtainin[g] in the Brahmaputra Valley. It necessarily follow[s] that, in a country where the population is sparse increases but slowly, and is too indolent or too prou[d] to engage in trade operations, it is not to be expecte[d] that it will contribute largely to the extension o[f] cultivation. For such extension we must look mainl[y] to the immigrant from Bengal. As soon as he i[s] brought in and induced to settle, new lands will b[e] taken up more rapidly than they are now, and crop[s] will be cultivated, both for home consumption an[d] export, as well as for supply to the many tea garden[s] that now are driven to import the rice they require fo[r] their labourers from the Province of Bengal.

MEETINGS FOR THE ENSUING WEEK

MONDAY, JUNE 8...Royal Institution, Albemarle-street, W. 5 p.m. General Monthly Meeting.
- Engineers, in the Theatre of the United Servic[e] Institution, Whitehall, S.W., 7½ p.m. Mr. Ernes[t] R. Matthews, "Electric Light Stations, thei[r] Design and Arrangement."
- Geographical, University of London, Burlington gardens, W., 8½ p.m.
- British Architects, 9, Conduit-street, W., 8 p.m.
- Actuaries, Staples-inn Hall, Holborn, 5 p.m. Annua[l] Meeting.

TUESDAY, JUNE 9 Asiatic, 22, Albemarle-street, W. 3 p.m.
- Central Chamber of Agriculture (at the HOUSE O[F] THE SOCIETY OF ARTS), 11 a.m.
- Alpine Club, 23, Savile-row, W., 8½ p m.
- Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.
- Photographic, 66, Russell-square, W.C., 8 p.m.
- Anthropological, 3, Hanover-square, W., 8½ p.m.
- Colonial Institution, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Right Hon. R. B. Haldane, "The Cabinet and the Empire."

WEDNESDAY, JUNE 10...Institute of Builders (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Dr. Hubert Higgins, "The Seasoning and Preservation of Wood."
- Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.
- Geological, Burlington house, W., 8 p.m.
- Japan Society, 20, Hanover-square, S.W., 8½ p.m. Annual General Meeting. Mr. A. Diosy, "In Memory of Will Adams, the first Englishman in Japan."
- Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.
- United Service Institution, Whitehall, S.W., 3 p.m. Major-General Luard, "Rifle Shooting as a Winter Evening Pursuit."

THURSDAY, JUNE 11...Royal, Burlington-house, W., 4½ p.m.
- Antiquaries, Burlington house, W., 8½ p.m.
- Society for the Encouragement of Fine Arts, 6½, Suffolk-street, Pall-mall, S W., 8 p.m. Mr. Joseph Offord, "A Forgotten People—the Hittites."
- Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, JUNE 12...Astronomical, Burlington-house, 8 p.m.
- Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

SATURDAY, JUNE 13...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

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FRIDAY, JUNE 12, 1903.

ll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the ne Hundred and Forty-ninth Annual Meeting r the purpose of receiving the Council's eport and Treasurer's Statement of receipts, ayments, and expenditure during the past ear, and also for the election of officers and w members, will be held in accordance with e By-Laws on Wednesday, 24th June, at p.m.

(By Order of the Council),

Henry Trueman Wood,
Secretary.

CONVERSAZIONE.

The Society of Arts Conversazione will be ld, by arrangement with the Council of the oyal Botanic Society, in the Gardens of that ciety, Inner Circle, Regent's Park, on esday evening, the 30th of June, from 9 to o'clock.

The reception by Sir William Preece, K.C.B., R.S., Chairman, and other Members of the uncil, will be held at the entrance to the nservatory near the Broad Walk from 9 to o'clock.

The central portion of the Gardens only will used. The Gardens will be illuminated h coloured lamps, and also by the Kitson candescent Oil Light. The Conservatory d the Club House will be open.

The Tropical House, containing a Banana nt in Fruit, and the Victoria Regia (the ant Water Lily, which it is hoped will be in wer by that time), and other interesting pical plants, will be open to visitors.

An Exhibition of Growing and Cut Roses d other Flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham Cross.

An Exhibition of Hardy Cut Flowers, by Messrs. Barr and Sons, of London and Surbiton, will be on view in the Corridor, including a special display of Peonies and Irises.

A Collection of Japanese Dwarf Trees will also be shown.

A Selection of Music will be performed by the String Band of H.M. Scots Guards in the Conservatory, and by the Band of the Royal Engineers in the Gardens, commencing at 9 o'clock.

A vocal and instrumental entertainment will be given by "The Follies" in the Club-house or (weather permitting) in the grounds.

Light refreshments (tea, coffee, ices, claret-cup, &c.) will be provided.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the Conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

It will greatly facilitate the arrangements if members requiring additional tickets will apply for them at as early a date as convenient.

The Council reserve the right of stopping the sale of tickets or of raising the price, if it is found necessary, in order to restrict the number of visitors within reasonable limits.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Tuesday afternoon, 8th inst. Present: Sir Steuart Colvin Bayley, K.C.S.I., C.I.E. (in the chair), Lionel R. Ashburner, C.S.I., Thomas Jewell Bennett, Sir M. M. Bhownaggree, K.C.I.E., M.P., Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D., Sir Caspar Purdon Clarke, C.I.E., F. C. Danvers, Thomas William Holderness, C.S.I.,

Sir William Lee-Warner, K.C.S.I., Henry Luttman-Johnson, Sir Patrick Playfair, C.I.E., Alexander Rogers, Sir Charles Cecil Stevens, K.C.S.I., Carmichael Thomas, Thomas H. Thornton, C.S.I., D.C.L., Arthur N. Wollaston, C.I.E., and W. Martin Wood, with S. Digby, Secretary of the Section. The arrangements for next session were considered.

Proceedings of the Society.

APPLIED ART SECTION.

On the occasion of the visit of the members of the Society of Arts to the Whitefriars Glass Works, by invitation of Messrs. James Powell and Sons, on Tuesday evening, April 28th, the following paper, "On Table Glass," was read by Mr. Harry Powell :—

Why or when a glass manufactory was founded in "Alsatia" I am unable to say definitely. The proximity of the river and the depreciated value of the property, owing to an evil reputation, may have been inducements to the original founder. The works must have been in existence before the end of the 17th century, for an advertisement of the wares produced, appeared in the *Tatler* in 1710, and the manufactory must have been in a tolerably advanced condition to warrant an advertisement in such an important periodical. The advertisement ran as follows :—

"At the Flint Glass-House in White Fryars near the Temple, are made and sold by Wholesale and Retale, all sorts of Decanthers, Drinking Glasses, Crewitts, &c., or Glasses made to any pattern of the best Flint, as also all sorts of common Drinking-Glasses and other Things made in ordinary Flint Glass, at reasonable Rates."

It is about the direct lineal descendants of these "decanthers and crewitts" that I am about to speak.

All table-glass, worthy of the name, is blown glass. Every vase, wine-glass, or decanter has commenced its career as a white hot, solid mass of viscous material coiled round the end of a long iron blowing tube. A well regulated puff of breath through the tube creates a bubble and the bubble is the embryonic stage of all table-glass.

The form of the bubble can be readily modified. Glass so long as it is hot is almost infinitely ductile, and even after it has been partly chilled its ductility can be restored by reheating. If the bubble, while still attached to the blowing iron, is held downwards it lengthens out into an ellipse ; if the blowing iron is held vertically with the bubble uppermost the bubble compresses itself into the form of a "scone," and if the "scone" is pierced in its centre, and the blowing iron is trundled like the handle of a mop the "scone" unfolds itself into a flattened disc. By these simple movements (which are in constant use in the glass factory) the form of the bubble is modified without the use of tools. With the aid of a primitive looking tool, closely resembling an exaggerated pair of sugar tongs, and of a stool or chair, with two parallel projecting arms, between which the workman sits, and on which he rests and rolls the iron rod to which the glass is attached, every imaginable modification of a spherical form can be developed.

At the present time, owing to a demand for excessive regularity and excessive lightness and thinness, very many of the simple forms of table-glass are blown in moulds. This process of moulding requires comparatively little skill, and the valuable training which the fashioning of simple forms with the tool affords, is being lost. If the fashion and demand for so-called "aerial" glass is long continued the skilled craft of glass blowing will disappear.

The English glass-blower (however clever he may be with his fingers) has no talent for design. He is painfully realistic, and if asked to produce a vase (without a pattern to guide him) will make an accurate model of a man's tall hat, a pair of bellows, or some other every-day piece of furniture, but will fail to create anything combining originality with beauty of outline. What technical education will do for the English glass-blower in the distant future remains to be proved.

The limitations of design are very strait. When what appears to be a fresh form or combination has been evolved, the discovery is generally made that the same has been done, and done better, ages before. Even when a satisfactory design has been produced, the designer may meet with unexpected difficulties owing to the wealth of possibilities of failure belonging to the craft. The would-be designer must closely and constantly watch the phases of form through which vessels pass, whilst being fashioned, and must note any outline that appears to be beautiful or novel. The most successful designs have been based on such study combined with the study of the productions of early Venetian, Dutch and German master-craftsmen.

In recent years, Mr. T. G. Jackson, R.A.

as one of the first to realise that a wine-glass may be something more than a bowl upon a stick, and that a graceful outline is not incompatible with utility.

About 1875, the late William Morris made several designs for table-glass, possessing, as all his work possesses, interest, beauty, and originality.

Mr. Albert Hartshorne has written and illustrated a voluminous work on the evolution of drinking-glasses. The chief variation is shown to have occurred in the leg, and the variation may obviously be almost unlimited. Legs may in section be solid or hollow, cylindrical or oval, square or oblong. They may be twisted; they may be, as it were, turned, with hollows, curves, and projections; they may be in one piece or in many pieces, and they may be ornamented with seals, frills, or "pinchings." Even the inside of an apparently solid leg may be decorated with plaited threads of coloured enamel, or with spiral air bubbles. These corkscrew lines of silvery air have a very simple origin. The leg is made from a small lump of viscous glass. Into this lump as many pin-pricks are made as spirals are required. The lump is then pulled out into a leg, and twisted at the same time. As the leg stretches and twists, the pin-pricks stretch and twist, and display themselves as spiral coils of air.

There is not the same scope for variation in the forms of decanters and jugs as there is in the form of drinking glasses and vases. The handles of jugs may be distinctly decorative, but are always treacherous. With the view of obviating the necessity for handles, decanters have been made with flat or dented sides so as to afford a secure grip for the fingers, but public taste has demanded that even these shapes should have handles affixed.

The display of niceties of form depends in no small degree on the chemical nature of the glass employed. For this purpose the soda-lime glass, which is used in Venice, and the use of which has recently been introduced in England, although it is seldom absolutely white, and often streaky and bubbly, is better adapted than the obtrusively brilliant potash-lead glass, from which English table-ware is commonly made.

The mention of the chemical nature of glass naturally introduces the subject of colour. Some thirty years ago the colours available and used for English table-glass were ruby, canary-yellow, emerald-green, dark peacock-green, light peacock-blue, dark purple-blue, and a dark purple.

About 1870 the "Jackson" table-glass was made in a light dull green glass, similar to that used in stained glass as "white," containing a wealth of bubbles and interesting irregularities. Owing to these so-called defects, the glass only appealed to a very select circle. The dull green, commonly known as "pale-green," was followed successively by amber, white opal, blue opal, straw opal, sea-green, horn colour, and various pale tints of soda-lime glass, ranging from yellow to blue. Experiments have also been tried with a violet coloured glass, a violet opal, a transparent black, and with glasses shading from red to blue, red to amber, and blue to green. Touches of colour have been added to vessels in course of manufacture by means of seals or tears of molten glass, applied like sealing wax; or by causing vessels to wrap themselves round with threads or coils of coloured glass. By the application of a pointed iron hook, whilst the vessel and thread are still ductile, the parallel coils can be distorted into bends, loops, or zigzags.

The surface of vessels may be rendered lustrous by rolling the hot glass on metallic leaf, or iridescent by the deposition of metallic tin, or by the corrosion caused by the chemical action of acid fumes. Gilding and enamel decoration are applied to vessels, when cold, and fixed by heat.

Cutting and engraving are produced by pressing the surface of vessels against the edge of wheels revolving on horizontal spindles. "Cutting" wheels range from 18 inches to 3 inches in diameter, and are made of iron for grinding, stone for smoothing, and wood for polishing. "Engraving" wheels are small, ranging from 1 inch to ¼-inch, and are made of copper.

It is the fashion to run down cutting as a form of decoration, a fashion which is partly due to a somewhat ill-advised pronouncement of Professor Ruskin. In appendix 12 of the second volume of "Stones of Venice," he says with regard to glass, "durability and transparency being the two peculiar characters of glass, all work in glass is bad which does not with a loud voice proclaim one or other of these great qualities, and, consequently, all cut glass is barbarous."

In making this statement Professor Ruskin evidently forgot that the power of reflecting and refracting light is also a peculiar and important character of glass. It is true that the

process of cutting was carried to an extreme pitch of vulgarity in the middle of the last century, but there are many specimens of English and Irish cut-glass of the 18th century of great refinement and beauty.

The true use of engraving is to add interest to vessels by means of coats-of-arms, monograms, inscriptions, and graceful outlines. The improper, but too common, use of engraving is to hide defective material.

In the Paris Exhibition of 1900, surface decoration was the prominent feature of all the exhibits of table-glass. The carved or "cameo" glass, introduced by Thomas Webb, of Stourbridge, in 1878, had been copied with varying success by glass-makers of all nations. Frequently the surface had been dulled by acid, so as to produce what is called a "satin" finish. M. Emile Gallé and Daum Frères, of Nancy, exhibited specimens of this form of decoration possessing considerable beauty. The so-called Favrile glass of Messrs. Tiffany, of New York, owes its effect in great measure to surface colour and lustre. The vases of Karl Koepping, of Berlin, are exceedingly graceful and fragile, but appear to be creations of the lamp rather than of the furnace.

I have already referred to the impetus given to the manufacture of English decorative table glass by William Morris and T. G. Jackson. I am unwilling to allow this opportunity to pass without mentioning two other benefactors of the craft of glass working, although their influence has only affected table-glass indirectly. To the one, Charles Winston, is due what may justly be called the renaissance of English stained glass; to the other, Sir W. B. Richmond, is due, the demonstration on a large scale that English mosaic work is a practicable form of structural decoration.

Winston was born in 1814, and died in 1864; he was a busy barrister, but devoted all his spare time to archæology, and especially to the study of stained glass of the 12th, 13th, 14th, and 15th centuries. In the pursuit of his hobby he examined nearly all the best examples of ancient stained glass in England, and made a large number of careful drawings from them. He satisfied himself (as stated in his memoirs published in 1865) that "the success of a glass painting depends as much on the quality of the material as on the skill of the artist." What he did for stained glass can best be illustrated from his own letters. Writing to his friend, Mr. C. H. Wilson, he says, "Ever since 1850 I have been amusing myself, at no small cost, in having analyses made of ancient glass. . . . I offered to Chance of Birmingham the analyses if he would attempt to work them out, but he refused. Ultimately Powell offered to take the matter up, and erected a furnace for the purpose. It is fortunate that he did offer, for without his aid there would have been no practical result, and had his place been further from the Temple I could not have attended to the experiments as much as I did. . . . I have had two windows done in the Temple Church (the round part) to commemorate our triumph. . . . The new material is as harmonious, brilliant, and at the same time solid in appearance as the old glass. . . ." Again writing in July, 1854, about a window in Lincoln Cathedral, he says "I do not see the slightest difference between it (the new glass) and the old, except the dirt. The ruby is splendid."

The coloured glass made for mosaic windows was for long known as "Winston's" glass. It was the origin of the stained glass branch of these works, and was a cause of contact with Burne-Jones, Morris, Ford Madox Brown, Poynter, Moody, J. Doyle, Albert Moore, Jackson, Wooldridge, Holiday, and other artists.

A letter, written by Winston in November, 1854, forms a link between his work and that of Sir W. B. Richmond. He writes:—"Dear Powell,—I have at last got some specimens of the glass mosaic work from St. Sophia, at Constantinople, and from St. Paul's, at Rome, which I have given to Mr. Clarke to analyse, and I doubt not you will soon be able to produce the same yourself." It was long before this prophecy was fulfilled. A period followed devoted to experiments in the manufacture of enamels and in technique. One relic of these experiments is an angel's head, executed in 1865. Subsequently, panels of glass pictorial mosaic were erected at South Kensington Museum, and pavements of glass mosaic were put down at South Kensington, at the Society of Arts, and in several churches.

In 1884, a large panel representing the central group of Raphael's "Disputa" was put up on the east wall of the morning chapel of St. Paul's Cathedral, and in 1887, Holman Hunt's picture of "Christ with the Doctors in the Temple," was translated into mosaic for the reredos of Clifton College Chapel. Both these works were executed in what is known as the "New Venetian" method., *i.e.*, they were

reated as panel pictures, and worked in a orkshop.

In 1891 Sir William Richmond, R.A., was ommissioned to carry out the decoration f the choir of St. Paul's Cathedral in glass nosaic. A study of these mosaics (all of vhich, with the exception of two angels of the assion at the extreme east of the choir, were xecuted *in situ*) will prove the superiority of ir W. Richmond's method of working. St. aul's affords ample scope for comparing he two methods (the "workshop" method nd the *in situ* method), for not only (as has lready been stated) are there examples of nglish glass-mosaic worked in the Venetian nethod, but there are important examples of enetian work in the pendentives of the dome, nd on the west wall of the morning chapel. If, however, further proof is needed of the uperiority of the *in situ* to the "workshop" nethod, a comparison should be made between some of the unrestored mosaics in Ravenna, which were certainly worked *in situ*, with nosaics in Rome and Venice, which have been "restored" by the Venetian method.

Sir William Richmond has proved that nosaic must be used as the coloured surface f a structure, and not as pictorial panels ixed to a structure. If this may be accepted s an axiom, the whole process of mosaic is normously simplified. There is no need for ninute shaping or fitting of the tesseræ. ndeed, so great is the covering power of old and coloured enamels, that in some ositions (according to the distance from the ye) the tesseræ may be placed at from $\frac{1}{8}$ in. to in. apart, and yet the whole service is adeuately coloured. There is no need of an xtensive palette, every shade and tint can be roduced by the contiguity of contrasted olours. By working *in situ* the ground itself. s well as every fragment and contrast of olour, can be given its full value. There is, noreover, no real difficulty in working *in situ* r of supervising the work.

It may be asked why, in a paper on "Tablelass," I should have referred to the work of Vinston and Sir W. Richmond. Their inuence, however, on table-glass, though indiect, has been of considerable importance. t was the manufacture of Winston's glass nat suggested the manufacture of vases and able-glass in soda-lime glass; and the pre-aration of the coloured golds and enamels for ir W. Richmond's mosaics suggested the ntroduction of many of these colours and ombinations of colours in the manufacture of table-glass. There is yet another reason for this apparent digression; stained glass windows and mosaics, as well as opaque glass tiles and "opus sectile," thermometer tubes, and pump-barrels, electric light fittings, and work in silver and in iron are all descendants and developments from the "crewitts, decanthers," and other simple forms of table ware which were advertised in the *Tatler* in August, 1710.

At the close of the paper the company inspected the show-rooms. The glass exhibited in the various show-rooms included the following:—Coloured table-glass; cut and engraved glass from old models; modern cut glass; modern engraved glass. Glasses copied from old pictures. The "Knossos" Jar, the Colchester Roman Vase, the Puzzle Bottle. Opaque glass: Tiles (plain and stencilled), coloured enamels and gold, used for mosaic, mother-of-pearl, and specimens of opus sectile.

On the walls were shown specimens of mosaic executed from designs by Sir W. B. Richmond, R.A., and a selection of interesting cartoons for stained glass. Among the latter were, "The Good Shepherd," "The Queen of Sheba," "Rebuilding the Walls of Jerusalem," "Adam and Eve," "St. Peter," "St. Paul," by Burne-Jones in 1857; "The Transfiguration," by Ford Madox-Brown; and "Moses and the Brazen Serpent," by Sir E. Poynter, R.A., drawn in 1857.

After leaving the show-rooms the visitors proceeded to the Glass-houses, and were shown the various processes of glass manufacture in actual operation. The following operations in glass-blowing were shown:—(*a*) Tube drawing (to illustrate the ductility of glass), (*b*) Threaded bottles, (*c*) Vases with "tears," (*d*) Museum jars, (*e*) Large vases.

Miscellaneous.

LIGHT RAILWAYS IN BELGIUM.

During last year the collective capital of the lines made by the Société Nationale des Chemins de Fer Vicinaux, the company formed under Government auspices for furthering light railway enterprise in Belgium, increased from 138,775,000 francs (£5,551,000) to 155,907,000 francs (£6,236,280); the total length of concessions accorded, from 2,610 kilomètres (1,622 miles), to 2,846 kilomètres (1,768 miles); the total length of railways worked, from 1,930 kilomètres (1,199 miles) to 2,080 kilomètres (1,292 miles), and the annual receipts from 11,026,989 francs (£441,079) to 11,566,660 francs (£462,667). Thus, while the amount of capital, with the lengths conceded and worked, followed generally the progressive increase that has marked the operations of the Société almost

from its foundation in 1885, the receipts, although they increased, have not quite followed the general upward movement, which is all the more noticeable because those of 1900 and 1901 showed a more accentuated increase. The causes of this diminished progression are referred to below.

At the beginning of last year the 110 lines conceded to the Société Nationale measured together 2,609·27 kilomètres (1,621 miles), while during last year and the first three months of the present, the concession of an additional 237 kilomètres (146 miles) in new lines and extensions, brought up the number of lines to 122, and the total length to 2,846·45 kilomètres (1,768 miles). This total includes a branch with double line of way measuring 3·34 kilomètres (say 2 miles) between the Baudour station on the Belgian State system and some works and also phosphate deposits, which affords an example of the useful ramifications of these secondary ines when the powerful aid of the Société is enlisted for promoting the development of industrial enterprises.

Of the above total, 106 lines, together 2,415·37 kilomètres (1,450 miles), are laid to the gauge of one mètre (3 ft. 3⅜ ins.), 12 of 403·76 kilomètres (250 miles) to the Dutch vicinal gauge of 1·067 mètre (3 ft. 6 in.), and 4 of 27·32 kilomètres (17 miles) to standard gauge.

Of the 101 lines opened for traffic all are worked by steam locomotives, except one by horses and the five following by electricity—Brussels to the Petite Espinette, 11·55 kilomètres; Lignes du Centre (la Louvière), 20·39 kilomètres; Charleroi and environs, 23·79 kilomètres; Liège, Tilleur, Grâce-Berleur and Rocourt, 16·2 kilomètres; and Ghent to Meirelbèke, 7·43 kilomètres, making together 79·36 kilomètres (nearly 50 miles).

The total of 2,846·45 kilomètres (1,768 miles) representing the lines actually conceded to the Société by the Government comprises the 2,158·4 kilomètres (1,340 miles) already opened, 426·1 kilomètres (265 miles) under construction, and 261·9 kilomètres (162 miles) to be made shortly. In addition to the above the Government has taken into consideration the eventual concession of 113 lines or portions of lines measuring together 1,991 kilomètres (1,236 miles), which, with five projects for new lines, as to which the Government's consideration has been applied for, affords the grand total of 240 lines, together 4,926·4 kilomètres (3,061 miles) long.

If the eight light lines conceded to companies independent of the Société Nationale be added to the above total, Belgium will be seen to be endowed with 130 light lines of 2,921 kilomètres (1,815 miles), constituting nearly 64 per cent. of the total length of the standard-gauge railways, which measure together 4,569 kilomètres (2,839 miles).

Among the lines now under consideration by the Government is that between La Louvière and Estinnes-au-Val, in the province Hainaut; and in this connection the Binche and La Louvière authorities have applied for powers to amalgamate the capital of that line and of another between Binch and Bracquegnies, that is partially open for traffic with a view to adopting electric haulage betwee Binche and La Louvière. After careful consideratio of the matter, the Société advises that the propose amalgamation be carried out, but that the line b worked by steam locomotives until the traffic sha justify the adoption of electric haulage.

Of the total length of lines opened for traffic b far the larger portion has been laid on ordinary road not widened, and only a very small proportion o widened roads or land bought for the purpose. N less than 97 points of union, not actual junction on account of the different gauge* are afforde with other railways, including 83 with the Belgia State system; and there are 255 private sidings including 174 with works and 80 with farms.

The rolling stock for steam haulage comprises 40 locomotives, 1,068 passenger carriages, 244 luggag vans, and 3,306 various waggons, together valued a 22,277,271 francs (£891,090) giving one engine f every 5·432 kilomètres (three miles) of way, on passenger carriage for 2·075 kilomètres (one mile and one goods waggon for 0.684 kilomètre (0·4 mile). The stock for electric traction comprises 11 electromotive carriages, 91 closed and 21 ope trailers, valued, with four ten-ton waggons, a 2,204,724 francs (£88,181), giving an electromotiv carriage for every 0·794 kilomètre (0·49 mile), an one trailer for every 0·78 kilomètre (0·48 mile) of way As the service has been increased, and requires stil further increasing on most of the lines that are worke electrically, fresh rolling stock has been ordered.

An offer by the Société Intercommunale Belg d'Electricité to furnish high-tension alternating cur rents, to be transformed to a lower voltage for directl supplying the overhead conductors, has been receive by the Société Nationale, which would thus be dis pensed from establishing a central station, so that th first cost and capital required for the lines in th Borinage, or Couchant de Mons, would be greatl reduced; and accordingly the project is being con sidered of applying electric traction to a whole net work of lines about 130 kilomètres (say 80 miles) long i the neighbourhood of Mons. If this arrangement b carried out the inhabitants of that district will have a their disposal not only traction, but also power an lighting by electricity on very advantageous terms.

With a total number of 12,871,482 kilomètre (7,998,114 miles) run over last year, there were 4 fatalities, including seven to passengers, chiefly owin to an endeavour to gain or leave a train in motion o to falling between two carriages, two to railwa servants, and the remainder to persons unconnecte with the lines and chiefly due to their own im prudence. The proportion of fatal accidents pe

* To avoid the expense and delay, incurred in transshipping goods when a break of gauge occurs, standard gauge waggons may now be carried over lines of narrower gauge by means o the Langbein transporter-trucks or the Leroy and Dulait electromotive trucks.

million kilomètres (run over) has diminished from 4·14 in 1898 to 3·5 last year.

The total receipts last year from all the lines and all sources amounted to 11,566,659 francs (£462,666), and the expenses to 7,889,941 francs (£315,597), showing a mean working co-efficicnt of 68·21 per cent. against 67·17 per cent. in 1901. In the case of 30 lines there was an increase in the receipts, and on 50 a diminution, which is attributed as regards passenger traffic to the continued bad weather, and as regards the goods traffic to three main causes, but chiefly to the general depression in trade.

Since the Société Nationale was founded in 1885, it has expended the sum of 108,640,223 francs (£4,345,608) in works and stock. Out of the lines opened for working at the end of last year, twenty-four show better results than during the previous year, twenty-one paid a better dividend and three, the working of which formerly entailed a loss, had made profits that have permitted a clearing off of the former loss by two of them, while the improved results on the third warrant the expectation that the account "loss on working" will soon be balanced. To meet any future losses of this kind the Société has reserve funds, both individual for each line separately and general for all of them, now amounting to 1,344,200 francs (£53,768), and 2,011,750 francs (£80,470) respectively. Among the lines that have been worked for more than a year 41 paid a dividend higher than that guaranteed, 7 one of 3 per cent., 13 of $2\frac{1}{2}$ per cent., and 9 more than 2 per cent.

RUBBER CULTIVATION IN MALAYA.

The following particulars from a recent report on *Hevea Brasiliensis* (the tree furnishing the Para rubber of commerce) in the Malay Peninsula, by Mr. Stanley Arden, Superintendent, Experimental Plantations, Federated Malay States, are quoted from the *London and China Telegraph*:—

In the year 1876, plants of Para rubber were forwarded direct from Kew to Singapore, and the following year Mr. Murton reported that "our climate is evidently suited for the growth of Hevea, judging by the progress the plants sent last year have made." It was introduced into Perak about the same time, by Sir Hugh Low, but whether he obtained his plants from Singapore or Ceylon, I have been unable to find out. That they were some of the original lot there is little doubt, for in 1879 he reports that "the Heveas are now 12 ft. to 14 ft. high. They take to the country immensely," and in 1883 he reports "the trees are now six years old." In the year 1887, some seeds were obtained from these trees, and planted in the museum grounds at Taiping; others were sown at Kummuning Estate (Perak), and a few years later at S'taiwan (Perak). There seems to have been very little interest taken in the product, however, by planters, presumably on account of the high prices ruling for coffee about this time, and with the exception of the trees cited above, there are very few trees in the Native States over four years old. But with a decline in the price of coffee, planters began to look for other cultivations, and during the season 1896-1897, the planting of rubber was taken up seriously. Since then its cultivation has received great attention, and there are, at the present time, in the Malay Peninsula alone, at least 12,000 acres planted with Hevea, representing about 1,500,000 trees, presumably the whole being the progeny of the trees originally introduced by the Government of India.

Mr. Stanley Arden goes on to give some figures as to the cost of opening and maintaining a plantation until it is productive. He makes his calculations upon a basis of 500 acres of land, planted with rubber 20 ft. by 20 ft. apart, being 108 trees per acre.

The total expenditure for five years is 64,875 dols., being an average of 50·55 dols. per acre for clearing and planting, and 19·80 dols. per acre per annum for upkeep, including the manager's salary. Taking the rate of exchange at 1s. 10d.—the average for the last two years—this is equivalent to £5,946 17s. 6d. sterling, or an average of £11 17s. $10\frac{1}{2}$d. per acre, to which must be added the interest on all money expended. Assuming that 50 per cent. of the five year old trees give an average yield of 8 ozs. of rubber per tree, which cannot be considered an unreasonable assumption, seeing that almost twice the amount was obtained from seven year old trees growing under very unfavourable conditions—albeit the tapping was somewhat severe—the yield per acre in the sixth year would amount to 25 lbs. of rubber. Taking the selling price in London at 2s. 6d. per pound (which is 1s. 1d. per pound less than has recently been obtained for well cured samples from Ceylon) this would be worth £3 2s. 6d. sterling; but as there is always a certain percentage of "scrap" rubber, it will be safer to estimate on an average selling basis of 2s., so that the yield per acre during the sixth year may be valued at £2 10s. From this must be deducted the cost of collection and preparation for market, which should not exceed 20 cents per pound—equivalent to 9s. 2d. per acre, also packing charges, freight and wharfage. The average cost per acre per annum for upkeep being 19·80 dols. or £1 16s. 3 3-5d. sterling, it appears probable that after deducting all expenses in connection with the preparation and marketing of the rubber, that the return during the sixth year will leave a small margin of profit, after allowing for upkeep, including the manager's salary and interest on the outlay. By the time the trees are six years old, 75 per cent. should give an average yield of 12 ozs., which is equal to 56·25 lbs. per acre. Valued at 2s. per pound, this gives a gross return of £5 12s. 6d. per acre, so that after deducting the cost of harvesting and marketing, there is every prospect of a fair return on the capital expended during the seventh year. By this time the cost of upkeep will have reached a very low figure,

while the yield will increase year by year, and should average at least 150 lbs. of rubber per acre by the time the trees are nine years old, and probably 200 lbs. the following year.

SOUTH AFRICAN TOBACCO.

Mr. Ed. Gould has contributed to the *Transvaal Agricultural Journal* an article on "Tobacco Growing at Barberton," from which the following particulars are taken :—

During six months of the year—from July to January—the growth of tobacco from seed requires incessant care and attention, starting at the nursery seedling stage, and ending only with the finished article of commerce.

It is of no use whatever for the beginner to undertake the labours and responsibilities of a tobacco planter unless he is prepared to relinquish every other pursuit for the sake of the crop, and completely devote himself to improving its cultivation.

Since the termination of the late war considerable public attention has been drawn to tobacco farming in certain districts of the Transvaal, but the merits of the Barberton district have not received much attention.

When the writer first entered De Kaap Valley, tramping from Delagoa Bay in 1885, the gold rush to De Kaap then absorbed all interest and capital. It did not, however, take long to see that De Kaap Valley and surroundings were sooner or later destined to become a farmer's sub-tropical Canaan. Good agricultural aspect, well watered and sheltered areas without a sign of frost, a climate apparently perfect, an alluvial rich red sandy loam on a limestone formation, cropping tembookie grass 7 feet high, and all kinds of tropical growths in profusion, at once indicated to the experienced planter that he was within the African Vuelta-Abajo of Tobacco Land. Against this must be recorded the De Kaap malarial fever that came with the long rank vegetation, and prostrated everybody not acclimatised. But by observance of enlightened precautions, and the use of modern medicines, malaria is now only equal to a bilious fever, and is by no means deadly.

The uncertainty of farm tenure in the De Kaap District, owing to its being in a proclaimed gold area, and no freehold obtainable by an Uitlander under the Boer Government, set back all would-be farm settlers' prospects. Then the exodus to Witwatersrand deprived Barberton of capital, and its mining and general trade followed. Subsequent events have also had their influence in preventing tobacco farming in De Kaap being successful.

Statistics agree that tobacco growing is one of the most profitable of rural industries.

As the tobacco crop is of a very delicate nature, liable to be damaged or destroyed by hail and wind, it will be wise of the settler to make every inquiry from neighbours and natives if the contemplated farm has been subject to hail in former years. In most parts of South Africa I have found hailstorms travel in zones. In East Griqualand I suffered from this three years in succession. In Salvation Valley, a spur of Crocodile Valley, running south to Da Kaap, the hail each year followed the hill tops on either side, leaving the valley beneath untouched, and yet within sight and hearing of hail. The experienced planter protects his plantation from wind according to his circumstances and opportunities. Mealies make a fairly good wind screen, producing early food for labourers. Sunflowers are a useful agent against wind, besides yielding seed for poultry, and fibre. I am now informed that the free cultivation of sunflowers is an antidote against malarial fever. Overhead vines and grenadillas are both effectual and profitable. Generally, autumn is the best season to commence occupations, as the settler has a chance of turning round, so to speak, clearing land, ploughing and cross-ploughing, to bring his lands into a fine state of tilth for the coming crop. The more friable the condition of the soil the better the crop in bulk and value. The tobacco plant revels in a warm, loose, red sandy loam, full of humus or decayed vegetable matter. Wood and grass ashes help the growth enormously, so that the grass fires of centuries have assisted the tobacco planter throughout De Kaap Valley.

The tobacco planter is responsible for the botanical properties of his growths, and the manufacturer for aroma and flavour. A high price is always commanded by those tobaccos that possess a fine golden colour and a good aroma. The ribs and veins should be thin and the former should branch off from the mid-rib at nearly right angles, and should be far apart from each other. Fine and valuable tobacco is a product of tropical countries only. Climate must always be considered first.

Taking for granted that tobacco growing is about to become an industry of the first magnitude in the Transvaal, suitable manures will have to be imported. Special Government facilities would have to be given in introducing suitable and cheap fertilisers for different districts, more especially to settlers in tobacco districts, even during the first years of occupation, in those cantonments not so favourably suited as De Kaap. No records are to be found of the tobacco yield in this valley, but it is said that all farmers engaged formerly were well satisfied with results, although they did not understand much about scientific cultivation. One man said he grew less than one acre, but he realised £270 for the crop. He possibly manured heavily, and sold raw leaf to natives. The yield on the writer's ground was carefully registered as averaging 1,600 lbs. per acre of dry manufactured tobacco. That realises 2s. 6d. per lb. wholesale to sell again. Result to grower, £200 per acre. The cost of production, covering everything, is £50 per acre. Net profit in six months, £150 per acre of tobacco. The wind fence crops of sunflowers

and mealies were extra profit; not being taken into consideration as they fed labour and poultry.

If the Government were to establish a central factory in De Kaap Valley to buy the raw leaf from the growers at a valuation for cash, local growers would be encouraged in producing early crops, besides being relieved of the troubles in connection with manufacturing details, which by right are outside the ordinary work of every small or large planter. But, on the other hand, it will pay a rich tobacco company, with a large area under cultivation, to have its own factory and machinery, because the profits in the factory are more than double that of the grower. Sorting, classification, and fermentations require skill and take time. Leaf preparing for cigars is very different to preparing smoking mixtures for the pipe, and the market price for the former is three times greater than that of the latter. Good tobacco is like good wine or whisky, it also requires maturing in bulk. The French Government absolutely controls the whole tobacco trade in France and her Colonies. The Government Régie is established in every district; it finds tobacco seed, and buys all tobacco grown locally for cash at a valuation. It is then classed and bulked for two years.

To bring this interesting subject to a focus, the Transvaal is a tobacco-producing country second to none in the world. The fertile valleys of the low lands are about one-third of the whole country, and are particularly suitable for tobacco culture, while for choice the De Kaap Valley is superior to any.

The feasibility of establishing a tobacco plantation and manufactory in De Kaap Valley is palpable. The object being to supply the British army and navy, as well as the public, with colonial grown tobacco. The enterprise would probably be self-supporting within twelve months, and the impetus given to the agricultural future of the Transvaal would be enormous.

ADMIRALTY CHARTS.

The Hydrographic Department of the Admiralty publish every two months a list of new charts, and of those which have received considerable additions or corrections.

The following is the list of those issued in March and April of the present year:—

New Charts.—No. 3353 to 3364—Tidal Streams, Channel Islands, twelve charts bound together in an atlas. 3315—England, south coast:—Straight point to Portland. 3302—Scotland, west coast:—Narrows of Raasay and Caol More. 3331 — Scotland. Hebrides, west coast:—Flannan Isles or Seven Hunters; Sulisker; North Rona. 3319—North American Lakes; L. Huron:—Goderich to Chantry Island. 1465—South America, east coast:—Sao Sebastiâo Island to Bom Abrigo Island. 3336—Aleutian Islands:—Unimak and Akutan passes and approaches. 395 — Africa, west coast:—Isles de Los, Konakri road. 3347—Japan:—Plans on the north coast of Nipon. 2035—New Zealand, north island:—Coromandel Harbour. 3338—Pacific Ocean; Gilbert islands:—South part of Nonuti. 2221—Black Sea; plans of Russian ports on the north shore; plan added:—Gagri anchorage. 2220—Black Sea; ports and anchorages on the south shore; plan added:—Kerasunda. 1535—Plans on the east coast of Iceland; plan added:—Horne fiord entrance. 1806—Africa, west coast; Great Fish bay to Walfisch bay; plan added:—Swakopmund road. 2662—Celebes; ports in Makassar strait; new plans:—Majene road and Balangnipa road. 3209—Celebes; bays and anchorages in Makassar strait: plan added: — Mampya road. 769—Admiralty and Hermit Islands; plan added:—Carola bay; new plan: – Hermit Islands.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—

No. 1610—England; North Foreland to Orfordness. 2966—Lapland; Port Ekaterininskoi and Pala bay. 2280—White Sea; Arkhangel bay. 2366—Germany, north coast; sheet II.; Arkona to Dievenow river. 2369—Germany, north coast; Rixhöft to Bruster-ort. 88—Spain, north coast; plans. San Sebastian; entrance of San Martin de la Arena. 1130—Sardinia; Cagliari bay. 1550—Iceland; Reydar and Faskrud fiords. 414—West Indies; Cuba; Havana harbour. 2677—West Indies, Leeward Islands; Culebra or Passage Islands. 804—West Indies, Leeward Islands; approaches to Pointe à Pitre, &c. 3107—South America, east coast; Cape St. Thomé to Guaratiba point. 2837*b*—Persian Gulf, northern portion. 2760—Sumatra; sheet I.:—Acheh head to Tyingkok bay. 2201—Sumatra; plans in. 709—Sumatra, west coast; Ujong Masang to Ujong Indrapura. 941*b*—Eastern archipelago, western portion sheet 2. 942*a*—Eastern archipelago, eastern portion sheet 1. 934—Eastern archipelago; Surabayi, Bali and Sapudi straits. 2636—Philippine Islands; strait of Makassar north part. 389—China, north-east coast: — Shanghai harbour. 1236—China, north coast; Port Arthur. 2657—Japan; Gulf of Tokyo. 2388—Russian Tartary; Sea of Okhotsk. 1750 — Australia, south coast; Port Adelaide. 2130 — Tasmania; Port Davey. 3269 — Pacific Ocean; Gilbert Islands (Tarawa lagoon). 968—Pacific Ocean; Ellice Islands (Mua and Mata Utiu anchorage.

These charts are issued by Mr. J. D. Potter, Admiralty charts agent, 145, Minories.

Obituary.

DR. COMMON, F.R.S., LL.D.—Andrew Ainslie Common, the eminent astronomer, who was the most successful constructor of reflecting telescopes of his time, died suddenly on Tuesday, 2nd

inst., at his house at Ealing. He was born at Newcastle on August 7th, 1841, and early devoted himself to astronomical work, having become possessed in 1874 of a $5\frac{1}{2}$ inch refractor. He afterwards constructed a 3 ft. reflector, and with it he obtained a splendid photograph of the nebula in Orion, for which he obtained the gold medal of the Royal Astronomical Society in 1884. He did not, however, remain content with his 3 ft. instrument, but undertook the task of making a 5 ft. reflector, with a focal length of $27\frac{1}{2}$ ft. He was the first to use silvered glass on a large scale for the mirrors of telescopes, although its use had been proposed by Steinheil and Foucault 20 years previously. Since 1895 Dr. Common devoted his attention to the sighting of guns of all kinds. He was elected a Fellow of the Royal Astronomical Society in 1876, and was President in 1895-96. He was elected a Fellow of the Royal Society in 1885, and member of the Society of Arts in 1882.

RICHARD MARSDEN.—Mr. Richard Marsden, editor of the *Textile Mercury*, died on Wednesday, the 20th ult., after a long-continued illness. He was born on February 10th, 1837, and began his business life, at the age of eleven, as utility boy in a printing and bookselling establishment. He subsequently entered a cotton factory, of which in course of time he became manager. He was for some 25 years editor (and, during the later part of his life, proprietor) of *The Textile Manufacturer*, a monthly magazine. In 1889 he founded the *Textile Mercury*, as a weekly organ of the textile industries, and continued to edit this journal up to the time of his death. For several years Mr. Marsden held the office of Examiner in Cotton Spinning and Manufacturing at the City and Guilds of London Technical Institute. He was the author of two text-books on cotton manufacture, viz., "Cotton Spinning" and "Cotton Weaving," and also wrote the articles on textile subjects in Spon's "Enclyclopædia of the Industrial Arts, Manufactures, and Commercial Products." Mr. Marsden was elected a member of the Society of Arts in 1883.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 15.. Optical, 20, Hanover-square, W., 8 p.m. Mr. W. Rosenheim, "Some Properties of Glass."

Victoria Institute (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., $4\frac{1}{2}$ p.m. Annual Meeting. Address by Prof. W. M. Flinders Petrie.

TUESDAY, JUNE 16...Civil Engineers, 25, Great George-street, Westminster, S.W., 9 p.m. ("James Forrest" Lecture.) Mr. W. H. Maw, "Some Unsolved Problems in Engineering."

Statistical (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 5 p.m. Sir William Chance, "A Decade of London Pauperism, 1891-1901."

Zoological, 3, Hanover-square, W., $8\frac{1}{2}$ p.m. 1. Miss Dorothy M. A. Bate, "An Extinct Species of Genet (*Genetta plesictoides*) from the Pleistocene of Cyprus." 2. Mr. G. A. Boulenger, "Description of a new Fish of the Gobiid Genus *Rhiacichthys* from British North Guinea." 3. Mr. G. A. Boulenger, "Descriptions of new Reptiles from British New Guinea." 4. Mr. Cyril Crossland, "The Marine Fauna of Zanzibar and British East Africa, from Collections made by Mr. Cyril Crossland in the years 1901 and 1902.—Polychæta. Part II."

WEDNESDAY, JUNE 17...Meteorological, 70, Victoria street, S.W., $4\frac{1}{2}$ p.m. 1. Dr. W. N. Shaw, "The Meteorological Aspects of the Storm of February 26th and 27th, 1903." 2 Mr. Joseph Baxendell, "The Dines-Baxendell Anemograph, and the Dial-pattern Non-Oscillating Pressure-Plate Anemometer."

Chemical, Burlington-house, W., 5 p.m. 1. Prof. T. E. Thorpe, (*a*) "The estimation of arsenic in fuel;" (*b*) "The electrolytic estimation of minute quantities of arsenic, more especially in brewing materials." 2. Mr. A. E. H. Tutton, "Crystallized ammonium sulphate and the position of ammonium in the alkali series." 3. Mr. A. Holt, junr., "Action of hydrogen on sodium." 4. Mr. A. Lapworth, (*a*) "The action of halogens on compounds containing the carbonyl group;" (*b*) "Reactions involving the addition of hydrogen cyanide to carbon compounds." 5. Messrs. A. C. O. Hann and A. Lapworth, "The acetoacetic ester synthesis." 6. Messrs. T. H. Easterfield and B. C. Aston, (*a*), "Rimu resin;" (*b*) "Note on the Karaka fruit."

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Lord Rayleigh, "The Theory of Optical Images, with Special Reference to the Microscope." 2. Dr. H. Siedentopf, "A Method of Making Visible Ultra-microscopic Particles in Glass and the Application of the Method to Bacteria." 3. Mr. E. M. Nelson, "The Lag in Microscopic Vision."

Mechanical Engineers, Storey's gate, S.W., 10 a.m. Engineering Congress. Opening Address by Mr. J. C. Hawkshaw.

THURSDAY, JUNE 18..Royal, Burlington-house, W., $4\frac{1}{2}$ p.m.

Antiquaries, Burlington house, W., $8\frac{1}{2}$ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. S. T. Dunn, "Descriptions of New Chinese Plants." 2. Mr. W. West and Prof. G. S. West, "Scottish Freshwater Plankton." 3. Mr. E. P. Stebbing, "The life history of a new Indian species of *Monophlebus*." 4. Mr. L. Lewton-Brain, "The Anatomy of leaves of British Grasses."

Mining and Metallurgy, at the Rooms of the Geological Society, Burlington-house, W., 8 p.m. 1. Mr. Henry F. Collins, "Adobe and other Cheap and Makeshift Furnaces." 2. Mr. Newton Booth Knox, "Dredging and Valuing Dredging Ground in Oroville, California." 3. Mr. S. J. Speak, "Milling in Northern Korea." 4. Messrs. A. P. Griffiths and F. W. Oldfield, "The Cyaniding of some Silver Ores by Percolation."

Historical, Clifford's Inn Hall, Fleet-st., E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

FRIDAY, JUNE 19...Royal Institution, Albemarle-street, W. Weekly Meeting, 9 p.m. Prof. Pierre Curie, "Radium." (In French.)

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Lecture on "Westminster Abbey."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Journal of the Society of Arts,

No. 2,639. Vol. LI.

FRIDAY, JUNE 19, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal*, in accordance with Sec. 40 of the Society's By-laws:—

TREASURERS' STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDING MAY 31ST, 1903.

Dr.

	£	s.	d.	£	s.	d.
To Cash in hands of Messrs. Coutts and Co., 31st May, 1902				2,309	11	0
,, Subscriptions	5,620	13	0			
,, Life compositions	693	0	0			
				6,313	13	0
,, Dividends and Interest				576	3	9
,, Ground Rents				645	14	4
,, Examination Fees				2,417	4	0
,, Clothworkers' Company (Donation to Examination Prize Fund)				30	0	0
,, Conversazione, 1902 (sale of tickets)				131	0	0
,, Advertisements				285	0	1
,, Sales, &c.:—						
"Cantor" Lectures	22	17	8			
Examination Programmes	35	6	4			
Fees for use of meeting-rooms	55	13	0			
Journal	116	11	7			
Miscellaneous Sales	1	8	3			
Howard Lectures	2	17	3			
				234	14	1
				£12,943	0	3

Cr.

	£	s.	d.	£	s.	d.
By House:—						
Rent, Rates, and Taxes	838	16	7			
Insurance, Gas, Coal, House expenses and charges incidental to meetings	310	6	5			
Repairs and Alterations	45	6	6			
				1,194	9	6
,, Office:—						
Salaries and wages	2,119	1	11			
Stationery, Office Printing and Lithography	442	5	1			
Advertising	101	17	0			
Postage Stamps, Messengers' Fares, and Parcels	300	1	8			
				2,963	5	8
,, Library, Bookbinding, &c.				101	3	9
,, Conversazione (1902)				501	0	6
,, *Journal*, including Printing and Publishing				1,929	8	7
,, Advertisements (Agents and Printing)				251	8	0
,, Examinations				2,073	16	1
,, Medals:—						
Albert	19	18	6			
Society's	28	18	2			
				48	16	8
,, Memorial Tablets				7	0	0
,, "Owen Jones" Prizes				4	7	0
,, "Shaw" Prize				19	0	0
,, "Fothergill" Prize				70	0	0
,, "Cantor" Lectures				198	1	6
,, Juvenile Lectures				20	0	
,, Sections:—						
Applied Art	60	0	0			
Colonial	45	7	8			
Indian	80	9	5			
				185	17	1
,, Committees (General Expenses)				17	14	6
,, Committee on Leather for Bookbinding				35	0	0
,, Fan Exhibition				19	11	9
,, Investments:—						
Life Compositions for the year, in War Loan	693	0	0			
Herring Bequest in War Loan	45	0	0			
				738	0	0
				10,378	0	7
,, Cash in hands of Messrs. Coutts and Co., May 31st, 1903				2,564	19	8
				£12,943	0	3

Liabilities.

	£ s. d.	£ s. d.
To Sundry Creditors	578 5 8	
,, Examiners' Fees	738 18 6	
,, Examination Prizes and Medals	119 10 0	
,, Sections:—Applied Art, Colonial, and Indian	160 0 0	
,, Accumulations under Trusts	475 19 11	
		2,072 14 1
,, Excess of assets over liabilities		24,188 10 1
		£26,261 4 2

Assets.

	Amount of Stock, &c. £ s. d.	Worth on 31st May, 1903. £ s. d.	£ s. d.
By Society's Accumulated Funds invested as follows:			
Consols	1,976 5 7	1,810 15 3	
Canada 4 per Cent. Stock	500 0 0	505 0 0	
South Australia 4 per Cent. Stock	500 0 0	522 10 0	
N.S. Wales $3\frac{1}{2}$ per Cent. Stock	530 10 1	535 16 0	
N.S. Wales 4 per Cent. Stock	500 0 0	550 0 0	
G. Indian Pen. Ry. 4 per Cent. Debenture Stock	217 0 0	273 8 0	
Queensland 4 per Cent. Bonds	1,500 0 0	1,560 0 0	
Natal 4 per Cent. Stock	500 0 0	575 0 0	
Ground Rents (amount invested)	10,496 2 9	10,496 2 9	
New River Co. Share (New)	100 0 0	440 0 0	
National War Loan	2,743 9 4	2,688 11 6	
	19,563 7 9		19,957 3 6
,, Subscriptions of the year uncollected		657 6 0	
,, Arrears, estimated as recoverable		220 0 0	
			877 6 0
,, Property of the Society (Books, Pictures, &c.)			2,000 0 0
,, Advertisements due			461 15 0
,, Cash in hands of Messrs. Coutts and Co., 31st May, 1903			2,564 19 8
,, Do. on Deposit (against interest on Trusts)			400 0 0
			£26,261 4 2

Funds held in Trust by the Society.

	£ s. d.	
Dr. Swiney's Bequest	£4,477 10 0	Ground-rents, chargeable with a sum of £200 once in five years.
"John Stock" Trust	100 0 0	Consols, chargeable with the Award of a Medal.
"Benjamin Shaw" Trust for Industrial Hygiene	133 6 8	,, ,, ,, of Interest as a Money Prize.
North London Exhibition Trust	192 2 1	,, ,, ,, ,,
"Fothergill" Trust	388 1 4	,, ,, ,, of a Medal.
J. Murray, in aid of a Building Fund	54 18 0	,,
Subscriptions to an Endowment Fund	562 2 2	,,
Dr. Aldred's Bequest	220 2 3	,, chargeable with the Award of a Prize.
Thomas Howard's Bequest	500 0 0	Metropolitan Railway 4 per Cent. Perpetual Preference Stock, chargeable with the Award of a Prize for an Essay.
Dr. Cantor's Bequest	2,450 0 0 2,695 11 3	Bombay and Baroda Railway Stock Ground-rents } Interest applied to the Cantor Lectures.
"Owen Jones" Memorial Trust	423 0 0	Canada 4 per Cent. Stock, chargeable with the Award of Prizes to Art Students.
"Mulready" Trust	105 16 0	South Australia 4 per Cent. Stock, the Interest to be applied to keeping Monument in repair and occasional Prizes to Art Students.
Alfred Davis's Bequest	1,953 0 0	Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock. Interest at the disposal of the Council for promoting the objects of the Society.
Amount to cover accumulated Interest on Trust Funds	400 0 0	On Deposit with Messrs. Coutts and Co.
	£14,655 9 9	

Total of Investments &c., Standing in the Name of the Society (including Society's accumulated Funds and Trusts as above).

	£ s. d.
Ground Rents (amount of cash invested)	£17,669 4 0
Consols	3,626 18 1
Metropolitan Railway 4 per Cent. Perpetual Preference Stock	500 0 0
Bombay and Baroda Railway 5 per Cent. Guaranteed Stock	2,450 0 0
Canada 4 per Cent. Stock	923 0 0
South Australia 4 per Cent. Stock	605 16 0
New South Wales $3\frac{1}{2}$ per Cent. Stock	530 10 1
New South Wales 4 per Cent. Stock	500 0 0
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock	2,170 0 0
Queensland 4 per Cent. Bonds	1,500 0 0
Natal 4 per Cent. Stock	500 0 0
New River Company Share (New)	100 0 0
National War Loan	2,743 9 4
Cash on Deposit with Messrs. Coutts and Co.	400 0 0
Society's Accumulated Funds 19,563 7 9 Trust Funds held by Society 14,655 9 9	£34,218 17 6

The Assets, represented by Stock at the Bank of England, and Securities, Cash on Deposit, and Cash balance in hands of Messrs. Coutts and Co., as above set forth, have been duly verified.

Owen Roberts,
Carmichael Thomas, } *Treasurers.*

Henry Trueman Wood, *Secretary.*
Society's House, Adelphi, 15th June, 1903.

Knox, Cropper, and Co., *Auditors.*

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Forty-ninth Annual General Meeting for the purpose of receiving the Council's Report and Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held in accordance with the By-Laws on Wednesday, 24th June, at 4 p.m.

(By Order of the Council),

HENRY TRUEMAN WOOD,
Secretary.

CONVERSAZIONE.

The Society of Arts Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the Gardens of that Society, Inner Circle, Regent's Park, on Tuesday evening, the 30th of June, from 9 to 12 o'clock.

The reception by Sir William Preece, K.C.B., F.R.S., Chairman, and other Members of the Council, will be held at the entrance to the Conservatory near the Broad Walk from 9 to 10 o'clock.

The central portion of the Gardens only will be used. The Gardens will be illuminated with coloured lamps, and also by the Kitson Incandescent Oil Light. The Conservatory and the Club House will be open.

The Tropical House, containing a Banana Plant in Fruit, and the Victoria Regia (the Giant Water Lily, which it is hoped will be in flower by that time), and other interesting tropical plants, will be open to visitors.

An Exhibition of Growing and Cut Roses and other Flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham Cross.

An Exhibition of Hardy Cut Flowers, by Messrs. Barr and Sons, of London and Surbiton, will be on view in the Corridor, including a special display of Peonies and Irises.

A Collection of Japanese Dwarf Trees will also be shown.

A Selection of Music will be performed by the String Band of H.M. Scots Guards in the Conservatory, and by the Band of the Royal Engineers in the Gardens, commencing at 9 o'clock.

A vocal and instrumental entertainment will be given by "The Follies" in the Club-house or (weather permitting) in the grounds.

Light refreshments (tea, coffee, ices, claret-cup, &c.) will be provided.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. These cards are now issued. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the Conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

It will greatly facilitate the arrangements if members requiring additional tickets will apply for them at as early a date as convenient.

The Council reserve the right of stopping the sale of tickets or of raising the price, if it is found necessary, in order to restrict the number of visitors within reasonable limits.

COLONIAL SECTION COMMITTEE.

A meeting of the Committee of the Colonial Section was held on Wednesday afternoon, 17th inst. Present: Sir Westby B. Perceval, K.C.M.G. (in the chair), the Hon. Sir John A. Cockburn, K.C.M.G., Sir John J. Grinlinton, and Sir William Preece, K.C.B., F.R.S., with Sir Henry Trueman Wood, Secretary of the Society, and S. Digby, Secretary of the Section. The arrangements for next session were considered.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

LIST OF MEMBERS.

The List of Members of the Society can be obtained by members on application to the Secretary.

Proceedings of the Society.

COLONIAL SECTION.

Tuesday afternoon, May 5, 1903; SIR JOHN SMALMAN SMITH, M.A., in the chair.

The CHAIRMAN, in introducing Major Ewart, said that he joined the 78th Highlanders in 1868, and subsequently served in Canada, Afghanistan, and Egypt. In 1882 he retired from the service, and was shortly afterwards appointed to the Gold Coast. In 1890 he commanded the Royal Niger Company's Constabulary; and in 1892 he was appointed Travelling Commissioner to the Colony of Lagos, in connection with which appointment Major Ewart's chief experience might be found. During almost the entire period of his official duties in Lagos, Major Ewart was travelling over the country, making himself familiar with the native customs and with the natives themselves, and was thus specially qualified to read a paper on the subject.

The paper read was—

LAGOS: ITS HINTERLAND, ITS PRODUCTS, AND ITS PEOPLE.

By MAJOR J. H. EWART.

Lagos is situated on an island in the lagoon which extends from the River Volta to the River Benin, formerly being an important point from which slaves were shipped to the West Indies. It was in 1861 that Lagos was taken by the boats of a British fleet, because the king would not give up dealing in slaves, the island being then ceded to the British Government and the first Governor appointed. In extent, the island is about four square miles, the present population being about 41,847. A little more than half a century ago the number of inhabitants was about 5,000, and they bore a very bad character. It is supposed that it was named by the Portuguese after Lagos in Portugal, when, in 1444, the inhabitants of that town formed themselves into an association to promote the exploration of Africa. Some natives are still living in Lagos who made money by exporting slaves; they are now dealing in palm oil and other produce. Lagos itself was subject to the King of Benin, who received tribute from the King of Lagos up to a very recent date.

There is a good harbour at Lagos, but owing to the entrance being blocked by a formidable bar, which is constantly changing, vessels drawing more than nine feet cannot enter. Passengers and cargo are transferred to small steamers outside the bar, and conveyed inside to the town, about five miles. Entering Lagos harbour, a stranger is at once struck by the beauty of the situation, and the prosperous look of the town. On the left side of the entrance is a fine lighthouse, erected in 1890 by Sir Alfred Moloney; on the right is the signal station and a few wooden houses, where some of the better class of natives live. Farther inside is a very large and very ugly building, where the Governor lives; there is a good sea wall, also Sir A. Moloney's work. Along the sea front are numerous well-built and airy houses, used as Government offices, private dwellings, &c.; these are built of brick and concrete. There is a fine Roman Catholic cathedral and several good-sized churches of different denominations. From the signal station to Ebutte Meta there is an electric tram, which crosses the lagoon by two fine iron bridges. Ebutte Meta is the terminus of the Lagos Government Railway, which runs to Ibadan, about 123 miles. At Ebutte Meta there is a good botanic garden, established by Sir A. Moloney to teach natives how to cultivate useful tropical plants. At Ebutte Meta there is now a prosperous town, with many good European houses, railway workshops, and large brick yards.

The temperature by day is about 80 degs., while at night it rarely exceeds 72 degs. There is always a very cool breeze which, if windows are kept open, keeps all mosquitoes away. The rainfall is about 70 inches. December, January, and February are the hottest months, when the *Harmattan*, a dry wind said to come from the Sahara, is blowing, and everything, books, papers, and people's faces are pinched and dried up. The colony is plentifully supplied with excellent fresh fish, including Barracouta, soles, and herrings; shell fish are always to be had, while good fresh meat and vegetables are also abundant. There is a constabulary corps of 700 men, and a civil police force of 400, both being armed with Martini-Metford carbines. They are officered by Englishmen, and are fairly useful bodies of men.

In 1890 the colony of Lagos merely consisted of the land on both sides of the lagoon as far as Retonu to the west, and the right bank of the Benin River to the east; up to that time no attempt had really been made to open up the country, and if any energetic official were

imprudent enough to start exploring on his own account, his exertions did not, to say the least, always commend themselves to the superior authorities. Indeed, he was given the choice of never venturing out of his own station or retiring from the service.

Badagry, 40 miles west of Lagos, the first of the Church Missionary Society's stations in this part of the West Coast, was a great place for collecting and shipping slaves. A mile and a-half from the lagoon is a good landing-place, where the surf is never bad. Badagry, it may be mentioned, was the starting-place for caravans going to the interior, and it was from this place that Clapperton, Lander, and others started. In 1849 there were about 10,000 people at Badagry which was ceded to Great Britain in 1863, with all its territory. The King of Dahomey was over-lord of all the country west of Lagos, as far as Badagry, and received tribute from all the chiefs in that direction until they were taken under the protection of the British Government. Since Badagry became part of Lagos colony it has, I regret to say, been neglected by the Government, the missionaries, and the merchants, and what was once a very prosperous town, is now practically ruined. One European merchant has a factory there, a native catechist lives in a decayed vicarage, the church is in the most dilapidated state, and the graveyard, where many Europeans have been buried, is a wilderness, and used for grazing cattle, while the gravestones have fallen down. On one occasion the King of Porto Novo, who disliked a certain commissioner who had died at Badagry, sent people to take the skull out of the grave, and now keeps it as an ornament in his house. No notice has ever been taken of this outrage, although the perpetrator was a British subject at the time. There is a good market at Badagry, which is attended by native traders from Lagos and Porto Novo. Large quantities of good fish are caught in the lagoon, but none of the natives will fish in the sea. About five miles east of Badagry is the Roman Catholic Mission Station of Topo ; it is situated on the land between the lagoon and the sea, in a nice healthy and breezy spot. The missionaries, who do much good in educating the native children, farm a large tract of land on both sides of the mission station and grow large quantities of European vegetables, including asparagus, which does well there. By some curious arrangement the Topo mission is not under the laws of the colony ; consequently there are constant disputes between the natives and the fathers, caused by the latter claiming and trying to enforce rights as to fishing and land which are most unjust. These disputes cannot be satisfactorily settled as long as the mission station is not amenable to the laws of the colony. Formerly Ketonu and Denham Waters, about 30 miles west of Badagry, belonged to the colony of Lagos, but in 1890 the French Government gave us the kingdom of Pokra, lying between Badagry and Porto Novo, in exchange for Ketonu and Denham Waters. In 1891 the late Sir John Glover, when Governor of Lagos, made a treaty with the ruler of Pokra by which his kingdom was taken under the protection of Great Britain. The people of Pokra always imagined they were under British protection and never had anything to do with the French, so the exchange was rather a one-sided affair.

From Ketonu the lagoon is navigable at all seasons of the year to Lagos for steamers drawing 8 feet. There is a regular weekly service by steam launch between Lagos and Porto Novo, and other steamers belonging to merchants ply between the two places for trade. The Yewa River, which enters the lagoon at Badagry, was opened and made navigable for steam launches for about 30 miles and for canoes about 20 miles further, tapping a very fertile district. This excellent water-way would be well worth keeping open.

I have referred to the bar at Lagos as a great obstacle to the port. In 1890 the Lagos Government had a survey of the bar made by an expert (Mr. Nagel), sent from England by the late Sir John Coode ; the result of Mr. Nagel's report was that Sir J. Coode undertook to open the bar for large steamers at a cost of £250,000, but this offer was not accepted. Since 1890 several other plans have been suggested, but by people who have no experience in this particular kind of work, or in estimating the cost of carrying out trade undertakings. Even if a good channel were made it is doubtful whether it could be kept open. At present, the mail steamers go to the settlement at Benin River. As there is a deep, wide water-way from Benin River to Arogbo (about 30 miles north-west), there is no reason why these steamers should not go to Arogbo and discharge their cargo into lighters at that place. Arogbo is about 120 miles east of Lagos ; steam launches drawing 6 feet can now go from Lagos to Arogbo without any difficulty. It would not be a very great under-

taking to dredge a deep and wide channel from Lagos to Leckie, 60 miles; the bottom is sand and mud. From there to Aboto, about 40 miles, there is a good, deep channel; the rest of the route could be cleared of snags and grass at a small cost. If this were done there would be no difficulty in lighters towed by steam launches going between Arogbo and Lagos. Between Lagos and Arogbo many large rivers flow into the lagoon, some of which are used by natives now. They might be made much more useful than they are at present. The sand bar across the mouths of all these rivers might be removed to allow of launches ascending them. The Ogun, which is fed above Abeokuta by the large rivers Oyan, Ofiki, and Iseyhin, is now used, during the wet season, by large canoes; the Oshun and Obi, entering the lagoon near Epe, might be utilised, also the Oluwa, the Owena, and the Ogbeshe.

In 1871, Sir John Glover travelled far in the hinterland. He made himself very popular with the natives, who, to this day, speak of him with veneration, settled many disputes between chiefs, and concluded numerous treaties, none of which, however, commended themselves to the approval of the Government of the day, West Africa, needless to say, not then being regarded with as much favour as it is now. After Sir John Glover's unsupported and unappreciated attempt to open up the hinterland, nothing was done until 1893, when the then Governor (Sir Gilbert Carter), with the permission of the Home Government, made a three months' tour, entering into treaties and getting in close touch with the native chiefs and people. One of the places Sir G. Carter visited was Abeokuta, a town of about 150,000 inhabitants, 80 miles north of Lagos, whose people until then had always been unfriendly to the Lagos Government. He also paid visits to Ibadan, where the population is said to be 200,000, and to many other large centres. In 1897, owing to French encroachments within the British sphere of influence, the boundaries to the north-west and north were more clearly defined. At present the boundaries of the colony are, on the west, the French colony of Dahomey; on the north, the 9th Parallel, north of which is Northern Nigeria; on the east, a line from the coast, passing through Arogbo to the 9th Parallel; to the east of this line are Southern and Northern Nigeria. The protectorate is estimated to cover 26,700 square miles, with a population of 2,000,000. How these estimates have been arrived at, is a mystery; no one really can say for certain what the area is, or, for the matter of that, what people live in the country. Both sides of the lagoon are covered with a dense mangrove swamp, from which most people are glad to escape as soon as possible.

The Hinterland is hilly, thickly wooded, and healthy; to the north there are large plains, with stunted bushes scattered over them. There is always a belt of forest on the banks of rivers. In the eastern district there are some hills about 3,000 feet high. The rains are heavier, and there is less dry season on the eastern side of the colony than on the west, in fact, it rains nearly every day in the eastern district. In the interior there is much less rain than near the coast.

The staple products of Lagos colony, are palm kernels and palm oil, both coming from the same tree, and costing the native much time and hard labour to prepare. The price paid to the producer does not leave anything for profit, all of which goes to the middlemen. For the last ten years, rubber has been collected, and is much more profitable, besides being easier work than collecting oil and kernels. Consequently, the latter trade has been very much neglected; there are, indeed, now thousands of acres covered with the palm oil tree, where nothing is collected, and the fruit is allowed to rot. There are four kinds of rubber in the Lagos forest. 1. The juice of the "Ire" tree, which grows slowly in damp ground, attains a girth of from 18 to 24 inches, and is ready to tap when about ten years old. 2. The vine "Ibo" rubber *(Landolphia)*. (this grows rapidly, and recovers soon after being cut; the juice is more valuable than that from the "Ire" tree, and is collected by cutting the vine, then beating the juice out; the root is never touched). 3. The Ceara rubber, very like the "Pappaw" tree to look at. This grows rapidly, and is ready to tap when four years' old. The juice should be allowed to dry on the tree after being tapped, then stripped off; this is a very valuable rubber. 4. The "Para," which grows well in the colony, and should be cultivated. It has been cultivated in the French and German colonies for some years, with good results. The rubber plants thrive and grow more quickly if the seed is allowed to fall in its natural way, and the young plants transplanted when about one year old, than when the seed is collected and sown in a garden.

A better quality and a larger quantity of rubber is collected if the trees are tapped

during the dry season. They recover during the wet season, and are ready to be tapped again the following season. The damage said to be done to rubber trees has been somewhat exaggerated. The Fantees collect the rubber carefully, and rarely do any damage, but natives, who do not understand the work, often follow the Fantees, deepening the cuts already made, and extending them all round the tree. The trees being tapped in the wet season have no chance of recovering, but dry up under the hot, dry harmattan, and, in many cases, die. If a trained official from the Indian Forestry Department were sent out, with a staff of Indians, to superintend and organise a proper forest department in West Africa, the rubber and timber industries would benefit largely. At present, amateurs, without any scientific training, are employed in the Forest Department. These officers work very hard, but know absolutely nothing about the work they undertake, and the natives who do know their own trees and plants thoroughly, are very much puzzled with conflicting orders. Locusts appear in large numbers late in October and November, doing much damage to late crops. If corn is sown early in July, so that the seed is fully matured in October, the locusts do not touch it, only eating the young fresh corn.

The "Piassava" fibre is very plentiful on both sides of the lagoon, but very little of it has ever been collected in Lagos. There is a good kind of cane growing plentifully, which is used by the natives for making baskets. It has been shipped from the Kameroons, for making chair bottoms. The croton oil seed might be of some value ; the Germans export it from their colonies. Beni seed, Gambia pod, straphonthus, dragon's blood, several kinds of gum and other vegetable products, grow abundantly in the Lagos Hinterland. Iroko or odum, a beautiful wood for making furniture, which white ants will not touch, which seasons rapidly, which does not warp much, and which lasts for a very long time when used as posts in the ground, might be of use in Europe. Ebony, camwood (three kinds), mahogany, cedar, and several other kinds of good hard woods are found in the forests.

There are many kinds of plants, the fibre of which is used by natives for rope and mat-making. The people make some really good pottery, and there are several towns where this industry is largely carried on. Canoe-making exists on an extensive scale in the eastern district, where vessels capable of carrying five tons are made. Tobacco is grown largely in the Hinterland, for home consumption, and also cotton, from which good strong thread is made, the cloths manufactured wearing uncommonly well. The hand-looms are much like those used in Morocco. Sir Alfred Jones, who has done more to educate the native of West Africa than any other man, and whose generous, disinterested kindness to Government officials, missionaries and others is well-known, has recently undertaken to convey cotton to England free of charge ; this is a great inducement to merchants and traders to buy cotton. Unfortunately, the farmer who produces the cotton will not benefit in any way from Sir Alfred Jones's generosity. Something should be done to give practical proof to the native farmer that the cultivation of cotton for export will pay him. There are large tracts of land where small quantities of cotton are now grown and where concessions would be granted to Europeans. These tracts are cleared of forest, and within reasonable distance of Lagos. The native, who will imitate anything, would soon learn, from example, to cultivate cotton on his own account. Corn and rice might also be grown with success. A sample of maize sent to Liverpool from Lagos, a few years since, was pronounced of good quality, and was sold for a good price. Two crops of maize are harvested every year. Yams of many kinds, bananas, plantains, &c., are largely grown. The natives have a regular rotation of crops. They cut down and burn the forest, sowing maize the first year. In the second year they dig the land over deep, and plant yams, then beans, beni seed, or other crops. In the fourth year the crop is maize again. They then leave the land to lie fallow for about three years. The crops are carefully weeded and kept clean. A small quantity of rice is grown in some parts, and good results are obtained. Arrowroot and ginger do well. The palm trees and all other timber belong to the owner of the land, but "kola" trees are recognised as the property of the person who plant them, whether they are growing on his land or not. All farms are clearly marked ; generally there is a fence of the croton oil plant, because cattle and other animals will not go near the plant, on account of its medicinal properties. Near every village, there are large herds of sheep and cattle—the latter resemble Jersey cattle in appearance—they are never milked, and are kept merely for the pleasure of having them. In the northern

part of the colony there are some fine humped cattle, which are milked, the natives using the milk themselves.

The fauna of West Africa is much the same as that of South Africa. Elephants, Leopards, Lions, Hartbeestes, Eland Koodoo, and many other kinds of animals are to be found in the Lagos Hinterland. Elephants can, even now, be seen not far north of Badagry, and in the forest between the Lagoon and Ondo. In the forest regions it is hard work to get any sport, and very difficult to find really good hunters. The real hunters are marvellous trackers, know every tree and plant, and are most interesting companions. Unfortunately Europeans are fond of telling natives that they do not know their own business, and the native hunter keeps out of their way. A common plan among Europeans is to send a hunter into the forest to mark down some game; when the sportsman is taken to the spot where the animal was last seen, and finds it is no longer there, he punishes the wretched hunter. There are many curious stories told in Lagos of sportsmen. One of these stories refers to a commissioner who tried to shoot an elephant with snipe shot out of a 12 bore fowling-piece. Another of the stories relates to an officer who said he bayonetted a hippotamus; unwisely he showed the bent bayonet and had to pay for a new one. For game hunters use a large arrow-head thickly covered with a mixture of the issa poison and the poison from the puff adder. The arrow is fired from a long trade, flint-block gun; it is deadly up to fifty yards. When an elephant is killed by this poison only the meat near the wound is damaged; the rest of the meat can be eaten by those who have a fancy for such delicate morsels.

The natives of Lagos itself are very mixed, Yorubas, Egbas, Popo's, Mahins, natives of the Gold Coast, Sierra Leonne, Kroo Boys and Syrianes. There are Pagans, Mohammedans, members of the Church of England, Roman Catholics, Wesleyans, American Baptists, in fact, every religion under the sun may be said to be represented. Many of the educated natives have been to Europe. These become clerks, doctors, missionaries, and lawyers, and they generally look down on the ordinary natives, whom they call "Aborigines," and whose language many of them do not understand. They pretend to be the friends and advisers of the native from the Hinterland, but give bad advice, and are not trusted by their *protégés*. The people of the Hinterland are Yorubas, Egbas, Popos, Mahins, and Ikales, who al speak a separate language and have differen laws and customs. The Yorubas, who ow most of the country, are a quiet, peaceabl people; easily led, and glad to acquire usefu knowledge. They originally belonged to th town of Ife, in the north-east part of th Protectorate. According to their traditions all the people of the world came originall from Ife. As their "world" is confined to th small portion of Africa round Lagos, Dahome and Benin, there may be some truth in thi idea. The Owa, or King of Ife, is the onl person in Yorubaland who can appoint king and other important chiefs. The Alafin of Oyo another influential magnate in the land formerly settled all political matters, but nov he has little power. The Egbas, coming fron some other part of the country, asked the Kin of Illaro for leave to settle in his country, an when this was granted, built the presen town of Abeokuta, which means "under rock;" *Kuta* being the native term for rock For a considerable time they paid tribute to th King of Illaro, but, about fifty years ago, havin assisted him against the Dahomeys, who ha raided his country, and having been successfu in defeating the invaders, the Egbas, accord ing to native custom, became overlords of al that country. The King of Illaro continue to pay tribute to them until 1891, when hi country was taken under the protection o Great Britain. The Yoruba and Egba lan guages are unwritten, and have no grammar Grammars have been invented by Europeans but the natives cannot speak or understan their language when Anglicised, and n European can understand a native when fairl set going to "sling" words. Succession t property is through the male line among th Yorubas.

The Popos are a large tribe, whose countr extends from Badagry to the Gold Coas colony; only a small portion of them live i Lagos colony, these being mostly fishermen and canoe men. They have a language whic is more like that on the Gold Coast than th Yoruba. Succession is through the femal line, whether to chiefship or property. Th King of Pokra traces his ancestors back fo more than 100 years.

The Mahins, who occupy the eastern distric from Leckie to the River Benin, inhabit a countr which is intersected by numberless creeks an is one huge swamp. Formerly these peopl did a large trade in piracy and in selling any one they could catch; they had very large an

ne canoes, well armed. Now that this con-enial occupation has been stopped they have one down in the world.

The Ikale, another tribe in the same district, re a purely agricultural people ; their country rich in timber, palm-trees and rubber. hese people prefer cutting trees down to ollect their fruit to climbing up them ; con-equently much ruthless damage is done to aluable trees. The Ikale country is divided nto several districts, each under a kinglet alled the Oloja, who is supreme in his own istrict. There is no one authority with more ower than the others ; occasionally all the lojas meet and settle laws for the good of e whole country.

The Baribas are a large Pagan tribe who o far have withstood all missionary efforts of he Mohammedans. Most of the territory of the Baribas is north of the 9th Parallel extending est to the Gold Coast colony, and on both ides of the River Niger. Their chief town, Niki, is in the French sphere of influence, and nly a small portion of the Baribas territory is n the Lagos Hinterland. They are a fine arlike race ; they breed and ride good ponies, nd have large herds of cattle, which they ilk and from which most of the beef in Lagos omes. Their king lives in British territory ; n 1897 he handed all his country over to the British, as all his people wished to be under ur protection. There was, it must be said, bit of a race between British and French fficers to get the Bariba king. The British ust did it ; but the French got nearly all the ountry.

The natives of the Hinterland are honest, ober, intelligent, and fairly hard-working. If llowed to do it in their own way they will do very good day's work and earn their pay ; permanently employed, it is not difficult to et labourers for 6d. a day. A drunken man a very rare sight, and when off the beaten ack very little spirit is seen, and what little ere is is so much adulterated that it is not ry deadly. Natives prefer palm wine and eir own native beer to European spirits. If, hen travelling in the Hinterland anything is st, and the owner tells the head chief in the strict, the missing property will generally be stored in a short time, much more certainly nd more quickly than it would be in Lagos, ith its well-trained police. It is wonderful hat good roads the native will make if shown ow to do it. In one district many miles of cellent roads, 12 feet wide, with bridges over l the streams, were made entirely by the natives, without a shilling being spent by the Lagos Government. Polygamy is common all over the Hinterland. In Ondo, polyandry is prevalent, the first husband being responsible for the upkeep of any children his wife may have, although she may have left him for years.

Chiefs and people are quite willing to give concessions to Europeans to work the native products, if allowed to get a fair proportion of the rent and taxes. Chiefs will always make alterations in their native laws and customs, if they are shown the benefit and object of the change, but they do not like to be hurried. The forest land should be placed under the supervision of a thoroughly trained forestry officer, who really understands his work, and would carry it out. The natives, at present, are very much puzzled at the constantly changing policy, and the contradictory advice they get as to the management of their country and products. Each European has different notions of what is the best plan of improving the native, and all have different ideas as to the way to collect rubber and timber, and to keep the trees from being destroyed. Each Governor of Lagos (and they do not stay long) has a different way of managing the native. The present distinguished Governor, Sir William MacGregor, has done wonders in opening up and settling the country ; he has travelled all over the colony, made extensive surveys, and established regular communication by steam launch with the different districts. When he leaves the colony all his schemes are, unfortunately, liable to be upset by his successor. The difficulties put in the way of Governors of Lagos anxious to improve the colony are enormous ; any new idea is objected to by both black and white.

As to the climate of the Hinterland, it is not as bad as it is supposed to be ; there is much more rain in the eastern districts than in the western, so, probably, the western side is the most healthy. If, when travelling, Europeans avoided camping in villages or market places, they would suffer very little from fever, mosquitoes, or other unpleasant things.

To sum up, there are many worse places than Lagos, and many worse people than the inhabitants of that region, who, if themselves treated fairly, treat Europeans very well indeed. Most of the sickness from which Europeans suffer is caused by their own mode of living. Until some cheaper means of transport is found for produce to the sea coast, and thence to Europe, it seems impossible that any of the

native products can compete with those from other tropical countries.

Much has been done in recent years to improve the sanitary arrangements in Lagos, and those who reside in or near the town have not much to complain of in this respect. Anything, however, is, I am sorry to say, considered good enough for officials who are condemned to live in the Hinterland. All good tents and hammocks are kept for those officials resident in Lagos who may by chance be ordered a brief trip up country. Native clerks as well as Europeans who leave Lagos for a few days are supplied with all comforts, but the officer whose business takes him to the Hinterland during the whole wet and dry seasons is never allowed decent camp equipage, and the poorest native hut is considered good enough for him to live in. It is only by good luck that the Europeans in the Hinterland survive at all; they are not even allowed medical advice unless there happens to be a large force of constabulary in their district.

APPENDIX.

Timber in Lagos Hinterland.

Egi.—This is very hard wood. When young, wood is white, when old it becomes a dark red. Is used by natives for making rafters, and lasts a long time. Grows near water, but does not grow very large.

Akun.—Grows near water, large, the trunk is rather twisted sometimes, is the only tree on which I have seen much moss growing. The natives do not make much use of the wood of this tree, as it is too hard for them to work.

Appa.—Grows near water, is white when young, red inside, when old grows to a large size. The female is much softer than the male. Natives use the wood for making mortars, posts, and small canoes.

Omo.—A hard white wood used for making drums.

Akokon.—A very hard red wood.

Iroko (called *Odum* on the Gold Coast).—The bark of this tree is a deadly poison. The wood makes very beautiful furniture, is fairly easy to work, and lasts a long time.

Appa obata.—A reddish wood, used for planks, canoes and posts.

Some Useful Native Products.

Gum copal, gum anime, ujia gum (this gum is scented). Turmerica, the root and stem give a yellow dye, the bark makes a strong rope. *Gutta-percha.* Pineapple fibre. Boko fibre. Issa seed, "Straphonthus Hisperidus." Dragons blood. Several kinds of pepper. Kopeck. Several kinds of cane. All these products are collected in the dry season.

DISCUSSION.

The Chairman, in opening the discussion, s the author mentioned that King Tofa, of Po Novo, once disliked a District Commissioner in neighbouring town of Badagry, and sent his peop after the poor Commissioner had died, to break his grave and take the man's skull therefrom, wh the King used either as a foot-stool or a drinkin cup, in order to show that thus should perish all enemies of the great Tofa. As far as it went t was right, but it was wrong to say that no notice w ever taken of the outrage, because the case happen to be tried by himself. The King was not amena to the ordinary process of the Court, but those wh the King employed to do his work were. They w arrested and brought down to Lagos. It was diffic to punish men for desecration of a grave, in fact, he not know that the Government could have punish them effectively for such an offence; but they h unfortunately for themselves, taken away with skull a piece of cloth in which it was wrapped. T natives were charged with a felony for stealing t piece of cloth, convicted, and sentenced to a lo term of imprisonment. He was in cordial agreeme with the author in regard to the development of t Arogbo channel, and it seemed to him strange th some development of the kind had not taken pla previously. It would be the means of preventi an immense loss to shipping; the merchan would be benefited, their goods would rea Lagos in a better condition, and he did n think it would cost any more to convey the if so much. He hoped the suggestion for t opening up of the Arogbo channel would in d time be carried out without attempting wh Sir John Coode said was impossible, namel to dredge the Lagos bar channel, and keep dredged so as to be available for steame With regard to the Yoruba people and countr Yoruba, as it existed a few years ago, was only wh was left of the ancient Yoruba, after it had be broken up by the constant wars which had tak place between the various tribes and Dahomey on t one hand and the Ilorins on the other. The Yorub were originally an up-country people, not a coa people, and it was only the pressure of the Moham medan converts from the north that gradually forc them down to the sea coast and made them occup Lagos. The constant wars in the early part of t 18th century served to feed the slavers in the gre *depôt* that was set up in Lagos. With the conn vance of the natives themselves, but chiefly of t Portuguese, that great *depôt* was fed by the consta wars that took place between the vanguard of t Mohammedans forcing their way down from t north, and the pagans, who were doing their best t keep them back. Treachery then intervened, an the Yoruba people split up, and thus became a easy prey; their various tribes became separated an

›stile to each other. Thus it was that the Yoruba now esented an appearance of a number of scattered tribes, ore or less hostile to each other, and not seeking in ıy way to further each other's interest. But origi-ılly the ancient capital of the Yoruba country, Oyo, ıd its great king. The Alafin of Oyo had control er the whole of the Yoruba country. Ifé, as e reader of the paper had stated, was originally garded by the Yorubas as the Eden, the birthplace, the Yoruba race. The king of the Yoruba country iginally controlled the whole of it, but he had now st a great deal of his power, in fact, his power was ıly nominal. The Ilorins, the Ibadans, and the rrounding tribes had revolted against him, and he mained now with nothing but a pretence of kingly ıwer. At no time were the kings of Yoruba auto-atic kings; their power was really nominal in all ses, they being controlled by the chiefs. The prime inister, the war chiefs, and the councils controlled e king, and the secret trade societies controlled the ıuncil. If the conduct of the king was not such as e authorities thought it should be, the king received present of parrot's eggs in a calabash—which was a ggestion that he should go to sleep, meaning at he should commit suicide, which he omptly did as a rule. He (the Chairman) ggested that the present condition of the Gov-nment on the West Coast of Africa, notably at ıgos, was a matter of great congratulation to those ıo, like himself, took a deep interest in the welfare the African people. Governors had been appointed imated by a desire to protect the people and their cient customs, and, if possible, to guide them into ›re humane and civilised paths. It was recognised, last, that West Africa could only be exploited by ack men; that it was a black man's country, d not a white man's — that the white man ght control and direct, but the black man must the active person to carry out the ideas. In view that fact, it was a matter of congratulation to find vernors who, instead of oppressing the natives by ce, and compelling them into a course of conduct d life which was foreign to their nature, and in ry way harmful to them, at last endeavoured to and see what was good and best in the native, his customs and laws, and to direct them if pos-le towards improvement—who had endeavoured to the systems of Government which had proved to so beneficial amongst the natives, instead of empting to use European methods, which the ives did not understand and resented.

Sir THOMAS FOWELL BUXTON, Bart., G.C.M.G., ›ught that Sir William MacGregor, who first served Fiji and then in New Guinea, was just the type of n needed in countries like West Africa. He had ıpathy with the natives, he showed his capacity drawing out all that was good in them, and for pressing the reverse. There were no doubt ong our race men, of whom the reader of the paper was one, who had sympathy with the natives, and others who had not; it might be they were not more to blame or to be commended for the class they belonged to any more than if their hair were black or light. At any rate, those who had the sympathy were the class fitted to be put into places of responsibility over the natives. The other class ought to be most rigidly moved from every position of the kind, because they did enormous harm and produced friction which had, time after time, led to disturbance, rebellion, and military expeditions, costing the country enormous amounts. He was very glad that Sir William MacGregor and his predecessors had been careful to select those who would be in sympathy with those under them. He thought the progress of the country, indicated by the paper, showed that the Government as a whole had been sympathetic and anxious for its benefit. Another question, which could not fail to suggest itself whenever one saw a map of the coast at present, was that it was divided up between European nations in a fashion which was more suggestive of a chess board than anything else, one bit belonging to the French, another to the Germans, and another to ourselves. He could not help thinking that something in the way of an exchange might, in course of time, be brought about, and the more friendly our relations the more easily such exchanges ought to be. He was not prepared to make any suggestion as to giving away this or acquiring that, but he could not help believing that was a policy which would help the peace and further the progress of the country. It was very gratifying to know how the trade of the country had gone on increasing, and how much more happy the relations were at the present time between the Governors and those under them. They had learned the great expediency of making use of the local chiefs, wherever possible using them in the governnent of the country, and training and directing them. In that way he felt sure they would make English ideas more easily acceptable to their subjects, than those who might go straight out from Europe and who dealt with the people themselves.

Mr. HERBERT SAMUEL, M.P., could not help thinking that the paper would make Englishmen more aware of the great possibilities and magnitude of our empire in West Africa, a portion of the empire which was likely in the future to be one of the richest and most thickly populated, as it was already one of the vastest parts of the British dominions. He would like to ask the author whether, in his opinion, the railway between Lagos and Ibadan was likely to be a successful and remunerative undertaking, and whether he approved of the project which was in the minds of the Government to continue it to Northern Nigeria, crossing the Niger to Kano. It would also be of interest if the author could say whether the system of local taxation worked successfully. Were

the proposals in regard to the hut tax acceptable in Lagos? Another important point was whether there were difficulties in regard to the supply of labour, and whether the natives were as idle as Englishmen were usually inclined to believe. Were they willing to work without undue pressure being brought to bear upon them? A few words on the comparative spread of Mohammedanism and Christian missions in the territory would also be of interest.

Mr. ALLEN UPWARD thought it was too generally assumed in England that the task of administering a black population was a matter which could be disposed of by a few simple rules laid down in black and white; but during his short tenure of office he was impressed with the fact that it was an exceedingly difficult art, which it required many years of experience to master. He thought the greatest problem which lay before the Government in that part of the world was to find men who could stand the climate, and get them properly trained in the art of dealing with the natives. The way to obtain such men was not by competitive examinations in English public schools, still less were they to be obtained by the system in vogue till a few years ago of sending the hooligan of the family out to the West Coast to drink himself to death. If the paper created an interest in the country and induced better men to go out it would do incalculable good. Those who were acquainted with the subject looked upon the author as one of the best type of administrators in that part of the world.

Mr. WALTER F. REID said the author had taken a very great interest in the products of the country, and had referred to certain staple articles of commerce such as palm oil and India rubber, but very little had been said of other products which he believed were plentiful in these tropical forests. He understood that the author had made a collection of such products, and had forwarded them to this country; he had stated that he had shipped a certain quantity of maize, and obtained a good price for it. It seemed to him that the first essential of a well-governed colony was that it should be self-supporting, and it could only attain to that position, in the first instance, by exporting sufficient of its produce to pay for the cost of government. The Germans and the French seemed to be developing their colonies in that part of the world very much better than the English; in fact one of the largest buildings in Lagos appeared, from a photograph shown, to belong to a German firm. He thought there was something radically wrong in the system we adopted by not making known the produce of the colonies, and in finding a market for it. For instance, it occured to him that he might make use of an oil which was produced on the West Coast of Africa, in one of our colonies, but he could not obtain it in this country, and had to go to Marseilles for it. He also wished to use fibre called kapok for a special purpose, whi[ch] was grown on the West Coast; it was chie[fly] used, he understood, for stuffing cushions and [so] on, but he could not obtain it in this country, a[nd] had to go to Holland for it. The fibre had seve[ral] uses, and he had made an excellent gun-cotton with [it] for which purpose it was preferable to cotton. [It] seemed to him that some means should be devis[ed] of bringing the different articles which existed in gre[at] numbers in tropical forests within the reach of t[he] manufacturers of this country. At the one end the[re] were the natives willing and ready to produce thin[gs] that would pay; at the other end there were factori[es] which could make use of the articles growing in pr[o]fusion; but the people who owned the factories or[ly] made use of certain articles which were produced [on] a large scale, and which could be bought on t[he] Exchange. Some means should be devised f[or] making known the articles to those who might u[se] them. There was one particular instance he cou[ld] quote in that respect, namely, the use of gutta-perch[a]. He believed it was at the Society of Arts that t[he] first sample of gutta-percha was shown; it beca[me] known to an enterprising German who happened [to] be in the room; it was sent over to Germany a[nd] tested, with the result that gutta-percha became [an] industrial article of great value. That was a pure[ly] accidental occurrence, but he thought in the prese[nt] case the matter might be arranged with a little mo[re] method. There were several organisations of manu[fac]turers and others in the country which carried on a[nd] took an interest in special branches of industry, and [if] a joint committee could be arranged between the So[]ciety of Arts and such other societies, he thought that committee could, with great effect, bring the matt[er] before the notice of those who wished to u[se] such articles. He referred especially to gum[s]. The author had spoken of gums as being e[x]ceedingly numerous in the forest. Useful gum[s] were rare articles, and probably some of the[m] possessed properties which were extremely valu[]able. He particularly mentioned the gum ka[uri] of New Zealand, which was used on a lar[ge] scale, had risen in price, was becoming e[x]hausted, and was absolutely necessary. There we[re] probably substitutes for it in the Colonies, and it w[as] time they were looked for. If the Society of Ar[ts] would take the initiative, and ask other societie[s] such as the Society of Chemical Industry and perha[ps] a Metallurgical Society for mineral products, to for[m] a joint committee for the purpose of bringing t[he] products to the notice of manufacturers who cou[ld] make use of the articles, it would greatly facilita[te] the development of the country. There were i[n]stances in which such joint committees had bee[n] extremely useful, for instance, the National Physic[al] Laboratory. Such a committee would benef[it] not only the Lagos colony but all the tropic[al] colonies. Now that England had a Colonial Offic[e] managed in a business-like way, such a scheme migh[t]

e adopted, which perhaps would not have been ossible in years gone by.

The COUNT DE CARDI said the author had touched ghtly on one question which was of vital importance ot only to West Africa, but to every part of the Connent, namely, the quality and quantity of liquor ›ld to the natives. The Government in South frica had done a good thing by passing laws proibiting the sale of drink to the natives. In West frica, the English colony was unfortunately laced, in that it was alongside a German and a 'rench colony. He believed the French would 'illingly stop supplying the natives with gin and ım, but the Germans had a large interest in the ·ade, and did not feel inclined to join in the moveıent. He knew all about the trade, because he was trader there himself some years ago, and sold many housand cases of gin, and knew exactly what harm : had done to the people. Up to the present, not ıuch harm had been done, but as the country was pened up, and European goods were sent into the ıterior, it would be a great pity if the trade ı drink were pushed as well. He calculated, n the basis of the supposed population, that ot more than half a pint of spirits annually er head of the population was at present sent ut, but if the trade increased it would be a very ad thing for the country. He was not a hard and ıst teetotaler, but he believed it would be a good hing for the country if England could prevail upon ermany and France to join in an agreement not to upply liquor to the natives.

Major EWART, in reply, said he was pleased to ear from the Chairman that the natives who took ıe skull of a Commisssioner out of his grave were everely punished. In reply to Mr. Samuel's quesons, although railways in other parts of the West 'oast were very necessary, he did not think, and ever had thought, that a railway from Lagos was kely to be of any use, or that it would ever pay. Iere were a large number of waterways running far ıto the interior, and he could not help thinking that ngineers might make navigable channels suitble for canoes and launches up all these rivers. 'raffic by water was cheaper than by rail-ay. The existing railway tapped only a very nall district ; it did not help the people on each de of it, and never would, while the freights charged 'hen he was there two years ago were enough to ighten the people in Africa, or anywhere else. The ırther the railway was extended the more expensive would be, and the less chance it would have of aying. For this reason he did not think it was of any se to extend the railway to the Niger. He did not ıink the imposition of the hut tax would do any harm ı the Yoruba country, because the Yorubas would ot pay it. If anybody asked them to pay a hut tax ıey would simply go away and build a hut somewhere else, but would not pay the tax. In regard to rates and taxes, in a small district, on the eastern side, the kings taxed the people for collecting rubber and other things, but they were never able to get the tax, so he (Major Ewart) agreed to collect it for them. He put a tax of £1 a year on all rubber collectors, and handed the revenue over, first, to the chiefs, who put it in their own pockets; as this did not answer he then divided it between the chiefs and the people. In return for this service the people made over 150 miles of very good roads, including bridges, which cost the Government absolutely nothing. Two years ago the Government imposed taxes on timber and rubber, and proposed to spend the revenue in paying for the railway and houses in Lagos, the natives receiving practically nothing. The natives naturally resented this. Sir William MacGregor told him that the natives would not agree to concessions being given, but he (Major Ewart) thought it was because the natives did not get the money for them. If the money collected in each district was spent in the district he believed the people would give any number of concessions. A great many persons had an exaggerated idea as to the number of natives on the West Coast. There were quite enough for the country, and he had no difficulty in obtaining efficient labour, at a cost of 5d., 6d., or 9d. a day per man, the Government paying 1s. 3d., far too high a price. Someone had recently suggested that labourers for South Africa could be obtained from Northern Nigeria. There were not enough people in the country for the purpose ; the West Coast would be ruined if the plan were adopted. The people could work in their own country in their own way, but they would not work in a European way somewhere else. He did not think the Mohammedans were increasing very much, and he would rather not say anything about the Christians. The Mohammedans were certainly the most reliable traders to deal with ; they could be trusted to pay at some time. With regard to the products of the country, a fibre was obtained from the silk cotton tree, and a still finer one from the pod of the rubber tree, being much longer and cleaner. Another very strong fibre, very similar to the stuff in an elephant's tail, would make good brushes for export. The difficulty was to get the natives to collect them for export ; they simply collected small quantities for their own use.

The CHAIRMAN, in proposing a vote of thanks to the author, said that Major Ewart, with his characteristic modesty, did not mention the fact that in the Bariba diplomatic struggle, between the English and the French, he was the Englishman who won the race, and secured the treaties with the Baribas. Although a great portion of that large country was assigned to France, those treaties had a great effect upon the subsequent negotiations.

The vote of thanks was carried unanimously.

Miscellaneous.

ITALIAN PETROLEUM.

When sailing in a direct line from the point of Posilipo towards Sorrento, and about five miles before reaching the Sorrento point, a strong smell of petroleum may be observed in calm weather. Two tracks of the smell are distinctly perceptible, the one at lat. 40° 41′ 30″, long. 14° 19′, and the other at lat. 40° 42′, long. 14° 18′ 30.″ Consul Neville Rolfe says, that the first time this was observed—he being on the yacht—it was attributed to the possible leakage from a petroleum tank steamer, or to the discharge of petroleum from a passing ship, there being no petroleum whatever on board the yacht, which was a sailing yawl. On the recurrence of the phenomenon, several months later, the party on board comprised a scientific gentlemen, who at once came to the conclusion that there must be a subaqueous petroleum spring at this spot, or near it, in a southerly direction. This casual discovery led to research on the subject, and to an enquiry into the presence of petroleum in other parts of the district of Naples. The only ancient record of the oil in the immediate vicinity of Naples, is that of the Bagno del Petroles which existed near the Stufe di Nerone, between Pozzuoli and Baia, that is to say, about 15 miles from the submarine source referred to above. This spring no longer exists, and the last mention of it was by Bartoloi, in 1679. It was much praised by mediæval writers for its hygienic properties, in cases of leprosy and cholera, and also for its curative effects on the limbs of patients, which they asserted it gave new vigour. In the neighbourhood of Naples, petroleum has been found in workable quantities, notably at San Giovanni d'Incarico, and at Pico, in the valley of the Liri, both in the province of Caserta. It is a fact that, as recently as 1878, 600 tons, or almost all the Italian petroleum came from Pico alone. In the last 20 years, the annual output has seriously decreased; it has become insignificant as compared with the increased production of the borings in Northern Italy. Petroleum has also been stated to occur at Tramutola, on the Gulf of Taranto, and asphalt is recorded on the east side of Abruzzi, about 20 miles from Pescara. Asphalt has also been found in the province of Salerno. The depth of the water—80 fathoms—at the spot in the Bay of Naples where the smell was noticed is too great for the collection of the oil to be commercially practicable, but the long continued escape of petroleum in the immediate vicinity of the Apennine limestones of the Sorrentine peninsula is an indication that deep borings might be successful, and might ultimately yield as profitable a supply of petroleum as the borings in Northern Italy, near Bologna and Piacenza. These extend along anticlinals of the tertiary limestone, and therefore are geologically similar in many respects to the country in or near which the newly discovered petroleum spring occurs.

Obituary.

MR. EDWARD WOODS, the eminent railwa[y] engineer, a Member of the Society of Arts of fift[y] years standing, died on Sunday 14th inst., at hi[s] house in Onslow-gardens. He was born in 1814 and at the age of 21 entered the service of th[e] Liverpool and Manchester Railway, then recentl[y] opened for traffic, and was soon afterwards appointe[d] its chief engineer. In 1838 a paper read by hin before the Institution of Engineers "On certai[n] forms of Locomotive Engines," was published in th[e] second volume of the quarto Transactions, whic[h] preceded the series of Minutes of Proceedings. I[n] later years he read several papers on railway subject[s] and other branches of engineering, before the Insti[-]tution, and he received the Telford Medal in 1840. He was President in 1886, and he also served a[s] President of the Smeatonian Society of Engineers and of the Mechanical Section of the Britis[h] Association.

General Notes.

PARIS HOUSE STATISTICS.—Of the 79,742 house[s] in Paris, 47,716 may be regarded, says *Le Journal* d[e] Paris, as very good, or good from a hygienic stand[-]point, and 32,026 as indifferent or defective. Out o[f] the above total 59,959 are provided with sprin[g] water, and 11,050 with both spring and river water, while 23,252 have modern sanitary arrangements. Lighting is effected by electricity in 4,651, by gas i[n] 57,740, and by oil or petroleum in 17,351. Th[e] number of Paris houses entirely warmed by calorifère[s] is 6,017, and of those provided with lifts 2,224.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 22...Farmers' Club, 2, Whitehall-court, S.W., 4 p.m. Mr. Rouse Orlebar, "The Boar[d] of Agriculture and the Development of it[s] Powers."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m.

TUESDAY, JUNE 23...Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W C., 8 p.m.

WEDNESDAY, JUNE 24...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4 p.m. Annual General Meeting.

Geological, Burlington house, W., 8 p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Fleet-Engineer G. Quick, "Reserves of Men an[d] Material for the Navy."

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

FRIDAY, JUNE 26...Physical. Chemical Society's Rooms, Burlington house, W., 5 p.m.

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FRIDAY, JUNE 26, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

The Society of Arts Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the Gardens of that Society, Inner Circle, Regent's Park, on Tuesday evening, the 30th of June, from 9 to 12 o'clock.

The reception by Sir William Preece, K.C.B., F.R.S., Chairman, and other Members of the Council, will be held at the entrance to the Conservatory near the Broad Walk from 9 to 10 o'clock.

The central portion of the Gardens only will be used. The Gardens will be illuminated with coloured lamps, and also by the Kitson Incandescent Oil Light. The Conservatory and the Club House will be open.

The Tropical House, containing a Banana Plant in Fruit, and the Victoria Regia (the Giant Water Lily, which it is hoped will be in flower by that time), and other interesting tropical plants, will be open to visitors.

An Exhibition of Growing and Cut Roses and other Flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham Cross.

An Exhibition of Hardy Cut Flowers, by Messrs. Barr and Sons, of London and Surbiton, will be on view in the Corridor, including a special display of Peonies and Irises.

A Collection of Japanese Dwarf Trees will also be shown.

A Selection of Music will be performed by the String Band of H.M. Scots Guards in the Conservatory, and by the Band of the Royal Engineers in the Gardens, commencing at 9 o'clock.

A vocal and instrumental entertainment by "The Follies" will be given, weather permitting, on the east lawn or in the Club-house from 9.15 to 10.15, and from 10.30 to 11.30 p.m.

Light refreshments (tea, coffee, ices, claret-cup, &c.) will be provided.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. These cards are now issued. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the Conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

It will greatly facilitate the arrangements if members requiring additional tickets will apply for them at as early a date as convenient.

The Council reserve the right of stopping the sale of tickets or of raising the price, if it is found necessary, in order to restrict the number of visitors within reasonable limits.

APPLIED ART SECTION COMMITTEE.

A meeting of the Committee of the Applied Art Section was held on Tuesday afternoon, 23rd inst. Present:—Sir George Birdwood, K.C.I.E., C.S.I. (in the chair), Alan S. Cole, C.B., Cyril Davenport, Lewis F. Day, Alfred East, A.R.A., Gerald C. Horsley, Sir Walter S. Prideaux, Halsey Ricardo, Hugh Stannus, Carmichael Thomas, with Sir Henry Trueman Wood, Secretary of the Society, and Henry B. Wheatley, Secretary of the Section. The arrangements for next session were considered.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

LIST OF MEMBERS.

The List of Members of the Society can be obtained by members on application to the Secretary.

Proceedings of the Society.

ANNUAL GENERAL MEETING.

The Annual General Meeting for receiving the Report of the Council, and the Treasurers' Statement of Receipts and Payments, during the past year, and also for the Election of Officers was held in accordance with the By-laws on Wednesday last, the 24th inst., at 4 p.m., Sir WILLIAM PREECE, K.C.B., F.R.S., Chairman of the Council, followed by Major-General Sir OWEN TUDOR BURNE, G.C.I.E., K.C.S.I., Vice-President, in the chair.

The SECRETARY read the notice convening the meeting, and the minutes of the last annual meeting.

The following candidates were proposed, balloted for, and duly elected members of the Society :—

Allom, Charles Garrick, 8, Mount-street, Grosvenor-square, W.
Arden, Stanley, Batu Tiga, Selangor, Federated Malay States.
Armstrong-Hopkins, Mrs. Saleni, M.D., Tyre, Seneca County, New York, U.S.A.
Arnott, Henry Dudley, Seacroft, The Cliff, Gorleston.
Balasubramanyan, N., M.A., Purasavakam, Madras, India.
Barton, James, Exchange-buildings, Dundalk, Ireland.
Berenson, Bernhard, I. Tatti, Settignano, Florence, Italy.
Betham, George Keys, 20, New Clive-road, West Dulwich, S.E.
Brackenridge, George Washington, San Antonio, Texas, U.S.A.
Brodie, H. C., Oxted, Surrey, and 110, Cannon-street, E.C.
Carrington, John Bodman, 14, Netherhall-gardens, Hampstead, N.W.
Chivers, John, J.P., Histon, near Cambridge.
Clark, Theodore Minot, 22, Congress-street, Boston, U.S.A.
Dawson, Robert A., A.R.C.A., Municipal School of Art, North-street, Belfast.
De Laessoe, Harold H. A., care of British South Africa Company, Limited, 15, St. Swithin's-lane, E.C.
Edwards, John Henry, C.S. *Norseman*, Western Telegraph Company, Pernambuco, Brazil, South America.
Farrell, John R., 30-31, Clement's-lane, Lombard-street, E.C.
Fremantle, Selwyn Howe, 44, Lower Sloane-street, S.W.
Fulton, Prof. Robert Burwell, LL.D., A.M., University of Mississippi, Mississippi, U.S.A.
Gower, John Henry, Mus.Doc., Windsor Hotel, Denver, Colorado, U.S.A., and Northington, Sutton, Surrey.
Hall, John, Silverlea, Chapel-park-road, St. Leonard's-on-Sea.
Halsey, Frederick A., "The American Machinist," World-building, New York City, U.S.A.
Hodgkinson, William, Messrs. Balmer, Lawrie, and Co., 103, Clive-street, Calcutta, India.
Horsley, John Reginald, Van Mines, Limited, Llanidloes, Montgomeryshire.
Humby, Henry George, M.Inst.C.E., 39, Victoria-street, S.W.
Janni, Chevalier Joseph, Riverbank, Sunbury-on-Thames.
Jeffreys, Richard Rice Vesey, A.M.I.Mech.E., The Rhodesia Railways Limited, P.O. Box 333, Bulawayo, Rhodesia, South Africa.
Kirkham, Rev. Philip H., M.A., St. Luke's, S.P.G., Toungoo, Burma.
Le Bas, Edward, 2, Glebe-place, Clissold-park, N., 18, Billiter-street, E.C., and Cyclops Works, Millwall, E.
Leonard, William John, Messrs. Carless, Capel, and Leonard, Hope Chemical Works, Hackney-wick, N.E.
Luboldt, F. W. August, "Breakspears," Hornchurch, Essex.
McGahan, Amos Harvey, F.S.I., Hayes P.O., Jamaica, British West Indies.
Matsukata, Kojiro, Kawasaki Dockyard Company, Limited, Kobe, Japan.
Menzies, John C., The Mazaruni Company, Limited, 314, East-street, Georgetown, British Guiana.
Miller, Allister M., Mbabana, Swaziland, South Africa.
Oakshott, Herbert Charles Gordon, M.A., Technical Institute, Grahamstown, Cape Colony, S. Africa.
Pfleiderer, Walter, 43, Regent-square, Gray's-inn-road, W.C.
Pope, William Hughes, Belle Vue, Folkestone.
Skelton, Robert, Municipal Engineer, Colombo, Ceylon.
Southon, Thomas Alfred, Broedersdraai, Haenertsburg, Transvaal, South Africa.
Sturdy, William, Paxhill-park, Lindfield, Sussex.
Temple, Bernard, "The Pioneer," Allahabad, India.
Timmler, Clement H., Fort Jameson, North-Eastern Rhodesia, *viâ* Chinde.
Vischer, Hans, M.A., Royal Societies Club, St. James's-street, S.W., and 14, Sonnenberg, Bern, Switzerland.
White, William Herbert, Assoc.M.Inst.C.E., 16, Cowley-street, Westminster, S.W.

The CHAIRMAN nominated Mr. John Jewell Vezey, and Mr. Adol Aronson, scrutineers, and declared the ballot open.

The SECRETARY then read the following

REPORT OF COUNCIL.

I.—Ordinary Meetings.

In the Address with which, according to custom, Sir William Preece, as Chairman of the Council, opened the session of the Society in November last, he further developed the subject which he had dealt with in the previous year, and laid down the basis of a Science of Business, showing how the commercial conduct of industrial processes arising from the practical application of discoveries followed distinct laws, and he sketched out a diagrammatic method by means of which the future development of any special business could to a large extent be indicated by a study of the curves derived from its previous history.

The first paper of the Session was a description of the new railway line which it is proposed to construct with a view of shortening the route from Dijon to Geneva and Lausanne, and connecting with the existing Rhone Valley line, thus developing the traffic through the Simplon Tunnel as soon as this tunnel is completed. The paper, which was read and published in the *Journal* in French, was by Dr. Gustave Goegg. The author laid much stress on the fact that for communication with the East the direct line through the Simplon would be shorter than either of the two existing routes by the St. Gothard or the Mount Cenis.

The next paper was by Mr. Alfred Watkins on "Photographic Development." Mr. Watkins's work on this subject is well known to photographers. He advocates the theory that, given a suitable developer, the quality of the resulting negative depends solely on the time of exposure, and can be affected but little, if at all, by any modification in the nature of the developer itself. He has evolved a system of "time development," which has attracted a good deal of attention, and argues that all that is required to produce a perfect negative is that the sensitive film should be exposed to the action of the developer for a certain time, which time is determined by the time of the first appearance of the image after the application of the developer. All that is required according to his theory is that the time of this first appearance should be noted, and the plate left in the developer for a certain multiple of this time, the multiple depending upon the developer employed, and being constant for that developer. The theory has been much debated in photographic circles, and though many hesitate to accept it in its entirety, it may be safely said that, as a rule, photographers are convinced of its approximate truth, and the general practice of photographic development has been to a large extent modified in accordance with Mr. Watkins's views.

Mr. Cloudesley Brereton's paper on "French Rural Education" was a valuable contribution to the discussion on educational matters which has been carried on so fiercely during the past two years, and showed how much might be learned from the experience of other countries. The same remark applies to a paper on "Education in Holland," which was read at a later period of the Session by Mr. J. C. Medd. Both Mr. Brereton and Mr. Medd were officially employed by the Board of Education to collect information on the Continent, and these two papers were supplementary to their official reports on the subject.

The last paper before the Christmas recess was by Mr. Archibald P. Head, on "The South Russian Iron Industry." It contained much valuable information on a subject about which not a great deal is known in this country. The supply of iron in the district referred to appears to be abundant, and is now being largely developed, mainly with Belgian capital.

After Christmas there were several important papers on economic subjects. The first of these was by Professor W. Smart on "Industrial Trusts." The tendency of manufacturers, both in this country and in America, to combine, is an important feature in the development of modern commerce, and one which is regarded with very different feelings by manufacturers generally. The advantages and disadvantages of the great combines of which the last two or three years has seen such conspicuous examples is a moot question. Professor Smart's paper was an extremely fair-minded review of the whole subject, pointing out its advantages and its disadvantages. Mr. Dixon Davies, in his paper on "The Cost of Municipal Trading," dealt further with a subject which he introduced to the Society in 1899. Mr. Davies's original paper was one of the first public announcements which drew attention to the conditions under which municipalities are engaged in undertakings conflicting more or less with individual industrial enterprises, and it was this paper which led to the keen discussion which has been waged on the subject ever since. In the paper which he read in January last the subject was further

developed. Mr. Davies, as is well known, is a vigorous opponent of the idea of municipal trading, and he put very strongly the arguments against it, the dangers which it involves, and the heavy financial liability which is being incurred. The paper led to a long and interesting discussion, which was continued over a second evening. Dr. Benedict W. Ginsburg's paper on "The Port of London" belonged to the same class. Dr. Ginsburg put in a brief, intelligible form a great deal of the information which has been collected by the recent Royal Commission, by the Mansion House Committee, and by other agencies. He was in favour of the constitution of a Port Trust, similar to the Mersey Docks and Harbour Board, and would give to that Trust much of the duties now discharged by various bodies, such as the Thames Conservancy, the Trinity House, the present Dock Companies, and other bodies. This paper also led to a vigorous discussion, in which the very varied opinions of those interested in the subject were somewhat strongly put forward. With these economic papers must also be classed Mr. T. Brice Phillips's Fothergill Prize Essay on "Existing Laws, By-Laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions," which was read at the meeting on the 11th of March. As is mentioned in another part of this report, the prize was unanimously awarded to Mr. Phillips by the Committee of Judges appointed by the Council, who fully appreciated the great mass of information and statistics which Mr. Phillips had collected from sources both in this country and abroad. Abstracts of the two other papers awarded smaller prizes, by Mr. George H. Paul and Dr. W. Craig Henderson, were also read. Mr. A. Sonnenschein's paper on "The Metric System," was an appeal for the adoption of this system as regards weights and measures, and an attempt to reply to the many objections which have been put forward to it. The speakers in the discussion were generally in favour of the proposition, as it appeared that nobody was present to advocate the retention of the existing system. Mr. William Schooling's paper on "New Aspects of Life Assurance" dealt with the modern development of life assurance, and recommended it as a method of investment.

Among papers dealing with more practical matters may be mentioned Mr. W. L. H. Hamilton's on "Methods of Mosaic Construction," in which the author recommended the system of building mosaic on a paper or other suitable backing in the workshop, and then transferring it to the wall to be decorated, a method which, in his opinion, offered very considerable advantages over the older process of building the mosaic itself on the surface where it is intended to remain. Mr. Harvey Dalziel's paper on "Three-colour Printing" dealt with the process from the point of view of the practical printer, a point which in discussions on the subject has been to a large extent overlooked. He compared the results of printing by chromo-lithography and by the three-colour process, and demonstrated that while the latter was applicable to work of an artistic character of which moderate numbers are required, chromo-lithography still holds its own for such work as is required for advertisement purposes, when sometimes a million, or two million, copies of a picture may be wanted. The main reason for the difference is the difficulty of securing a satisfactory result with the three-colour process when machines are running at a high rate of speed.

Mr. Arthur Kitson gave an account of the development of "Petroleum Incandescent Lighting," by the method known as the Kitson light; in this, petroleum is volatilised by the lamp itself, and burned as gas with an incandescent mantle.

"The Application of Polyphase Motors," by Mr. Alfred C. Eborall, was a valuable, if somewhat technical, discussion of the class of motors best suited for the electrical driving of workshops and factories.

Mr. Walter F. Reid in his paper on "Modern Bee-keeping," advocated the development of a very ancient but minor industry, that of the production of honey. Although, thanks to the labours of the British Bee-keepers' Association, this useful cottage industry has grown considerably of late years, it is yet capable of further and useful development.

Mr. T. A. Brockelbank, in 1876, read a paper on his system of "Automatic Wagon Couplings," and this Session he again brought the subject before the Society. The figures which he gave as to the loss of life in shunting operations were, as those who have followed the subject know, appalling, though they have been reduced by the improved appliances introduced of recent years, and the subject is one which both deserves and receives the attention alike of the Board of Trade and of the railway authorities. It was, however, evident from the discussion which arose, that there are a great many serious difficulties in the way of the introduction of automatic

couplings, one of the most important, perhaps, being the decision which will have to be arrived at as to the coupling, the use of which legislation might enforce upon all railways alike, since it is obvious that whatever coupling is employed, all railway companies will have to use the same.

Mr. F. W. Carey in his paper on "Tonkin, Yunnan, and Burma" gave a very interesting account of these countries derived from personal experience of travelling in them.

Mr. E. North Buxton made an earnest appeal for the Preservation of Big Game in Africa in his paper devoted to that subject. He gave an account of the preserves already formed, pointed out their advantages, criticised their defects, and offered suggestions for their further development. Mr. Buxton's arguments were endorsed by many who took part in the discussion, and who spoke from actual experience of African sport and travel.

In his paper on "The Construction of Maps and Charts," Mr. G. J. Morrison succeeded in making a very technical, and naturally dry, subject both interesting and intelligible. Probably few of us are aware how much our general ideas of geography are confused by the conventional projections on which our maps are constructed. Mercator's projection, invaluable as it is, has a great deal to answer for in this respect.

The work of the session was concluded by a very interesting paper by Mr. Egerton Castle—himself a master of the art of fencing—on "Swordsmanship considered historically and as a Sport." Mr. Castle briefly traced the development of the art of fencing, and his paper was illustrated by practical demonstrations of the use of the sword, commencing with the old sword and dagger method, and concluding with the modern development of fencing, in which a somewhat heavier and stiffer representation of the duelling sword takes the place of the light and flexible foil.

The Society has held in all 57 meetings this Session, including the sectional meetings and the Cantor and Juvenile Lectures.

II.—Indian Section.

The thirty-fifth session of this Section has on the whole been of more than usual interest, and the usefulness of this branch of the Society's work appears to be increasingly appreciated in India as well as at home.

The experiment of including in the sessional programme one or more papers descriptive of the provinces and capitals of India has met with so much approval that it has been decided to continue the series until the whole of India has been dealt with in this way. Two provinces were treated during the past session. Sind by Mr. Herbert Birdwood, and Assam by Sir Charles Lyall. Mr. Birdwood drew attention to the importance of his old province in connection with the "restless Middle Eastern Question," expressing the opinion that Karachi, the nearest Indian port to Aden on the Persian Gulf, cannot fail eventually to become the pivot of our whole Indian political system. Sir Charles Lyall enlarged upon the remarkable anthropological features of Assam, suggesting that it is doubtful whether there is any part of Asia where so small a population (6,126,343) presents such diversities of ethnical life. Both in the paper and in the discussion much was said respecting the greatest want of Assam—a larger population. The author is of opinion that for colonisation we must look mainly to the development of the tea industry, and to the opening out of the country by improved communication; while the chairman, Lord George Hamilton, who described Assam as a great industrial asset, suggested that it might help to solve the problem of over-congestion elsewhere in India.

"Domestic Life in Persia" was the subject of a charming and instructive paper read by Miss Ella C. Sykes, who during her residence in the country enjoyed unique opportunities of acquainting herself with the social customs of the people, and who, in company with her distinguished brother, Major Molesworth Sykes, travelled in parts never previously visited by a European lady. Miss Sykes is also the first lady to read a paper before the Society's Indian Section. Mr. J. D. Rees, in his paper on "Domestic Life in India," characterised the anti-caste attitude, of which he disapproves, as an anti-Hindu attitude, and raised several interesting points, which led to an animated debate.

Mr. J. A. Baines supplemented his previous contributions to the Society on Indian census work by an interesting paper reviewing, under the title of "Gleanings from the Indian Census," the more important results of the year before last. He referred to the effect of the recent famines in checking the growth of the population in certain areas, and mentioned the singular fact that it is the women of India who bear the stress of scarcity better than men. He also pointed out that while in almost all the great sea-ports, except

Bombay and Karachi, the ratio of females tends to decrease, the reverse has been the case since 1891 in the large towns of the interior. Much further information on these and other points was brought out in the discussion that followed.

The remaining paper was read by Mr. J. Barr Robertson, the subject being "The Currency Policy of India." In his survey of the financial situation of India as it existed before and after the adoption of the new policy in 1893, the author argued that the closing of the mints was, in the circumstances he described, inevitable, and that in its results that measure was one of the most fortunate events in Indian history, inasmuch as it provided the means of maintaining the economic position of the agricultural, labouring, manufacturing, and trading classes, unchanged and unimpaired so far as any currency policy could accomplish that object; and at a time when but for this policy India would have passed on to currency conditions which would have produced national disaster.

III.—Colonial Section.

The Countess of Aberdeen opened the session of the Colonial Section with an interesting and picturesque paper on "Women in Canada," in which she summed up the chief impressions made upon her by close intercourse and friendship with them for several years, official and non-official, by the word "efficiency." French, Canadian, Manitoban, Nova Scotian, British Columbian, and residents of Ontario, are universally, she maintains, hall-marked as "efficient." The paper included a brief description of the notable reforms effected by the National Council of Women of Canada, and conveyed the idea, desired by the authoress, "that the daughters of Canada are worthy of that land of sunshine and commerce, and that women who are seeking a new home will find no better country, nor one where they will have fuller scope for the exercise of their abilities."

In his paper on "The Uganda of To-day" Mr. Herbert Samuel, M.P., gave a very encouraging account of the progress made in that Protectorate. The change, he declared, has been dramatic, and speaking from careful observation during his visit to the country, he says it is difficult to over-estimate the probable effects of the development both to Uganda and all British East Africa that will ensue from the building of the railway from Mombasa to the Victoria Nyanza. Some comments by Mr. Samuel on the cost of the railway were challenged at the meeting, and subsequently replied to in greater detail in the *Journal* by Sir Francis O'Callaghan.

In a paper on British North Borneo Mr. Henry Walker gave what the Chairman, Sir George Goldie, described as not only a valuable but a very satisfactory and hopeful view of development of one of the most promising of our more distant possessions. It appeared that Borneo, in common with some other portions of the Empire, suffers from thinness of population, and Mr. Walker mentioned that the adoption of means by which settlers may be attracted from adjacent countries is being carefully considered. The paper referred to the harbour of Gaya as a possible site for the naval base which is recommended for the security of our position in the Pacific. The Chairman urged the necessity of establishing such a base, but Admiral Sir Edmund Fremantle seemed to think that it might be deferred.

"The Lagos Hinterland: its People and its Prospects," formed the subject of a very useful paper read at the concluding meeting by Major J. H. Ewart, who, speaking from many years' experience as an official in West Africa, and as one who enjoyed the confidence of the natives, presented much information of a character that cannot fail to be of value to those who in Liverpool and elsewhere are specially interested in the commercial development of a portion of the Empire which seems to have considerable industrial possibilities. Several well-known West African experts joined in the discussion.

IV.—Applied Art Section.

Mr. G. F. Bodley, R.A., gave at the first meeting of the Section for this session his views on "Some Principles that may be Guides for the Applied Arts." He asked if art was only inspiration or merely imitation, and answering that it was both, he pointed out that it therefore required the guidance of principles. Those to which he directed special attention were: 1, Truth to nature; 2, expression of life; 3, beauty, delicacy, and refinement; 4, breadth of effect; and 5, accurate treatment of colour.

At the second meeting, Mr. Douglas Cockerell read a paper on "Technical Education in connection with the Book-producing Trades," in which he urged the absolute need of a better understanding between the various craftsmen employed in the production of books. The two chief trades

alluded to are printing and bookbinding. The printer is dependent upon the paper maker, the typefounder, and the ink maker, while the bookbinder is dependent upon the leather seller, the maker of cloth, cord, thread, silk, millboard, &c. Mr. Cockerell proposed a scheme of classes for a school of book production, where the craftsmen in different branches might learn the requirements of the others, and he expressed the opinion that carefully organised technical schools might help to remedy the defects of the present workshop training, and take the place of the old apprenticeship. The Chairman, Dr. William Garnett, agreed generally with Mr. Cockerell's suggestions, and said that he should like to see an institution in London which would deal with the production of a book from beginning to end.

Mr. George W. Eve read a paper on "Heraldry in Decoration," in which he showed the great possibilities of a free and vigorous use of heraldic details in decorative design. He said that if heraldry was nsed it must be used in such a way that it could not be misunderstood, but when correct in principle the decorative treatment might take the course that seemed most fit.

Miss Hannah Falcke, in her paper on "Artistic Fans," after tracing the history of the fan from the earliest times paid special attention to the development of the art of fan making, more particularly in France, Spain, and England. The Chairman (Sir George Birdwood) added a full explanation of the gradual evolution of the fan and illustrated his views by types of ancient Oriental, and modern Indian fans.

In connection with this meeting a small collection of historic and modern fans was shown in the library from March 17th to March 25th. The exhibition consisted of a fine collection from the Victoria and Albert Museum, lent by the Board of Education, and others lent by distinguished collectors, as well as fine examples of modern fans lent by Messrs. Liberty and Co., Marcot, Marshall and Snelgrove, Debenham and Freebody, &c. A catalogue of the collection will be found in the *Journal* for April 10th, 1903 (p. 504).

On April 28th, a party of members of the Society, to the number of 100, visited the Whitefriars Glass Works, on the invitation of Messrs. James Powell and Sons. On this occasion Mr. Harry Powell read a short paper on "Table Glass," after which the company visited the various show-rooms and glass-houses. The different processes of ornamental glass manufacture were shown in actual operation, and these processes illustrated the points to which attention had been drawn in Mr. Powell's interesting paper. The beauty of the demonstration, and the completeness of the exhibition, were largely appreciated by the visitors.

The last paper of the session was by Mr. Cyril Davenport, on "Mezzotints." The author fully explained the process of mezzotint engraving, and showed the tools used. He also exhibited on the screen a series of lantern slides of some of the finest examples of mezzotint taken from brilliant proofs. In the discussion that followed the reading of the paper attention was called to the Loan Exhibition of British Engraving and Etching now open at the Victoria and Albert Museum, South Kensington, which had been formed by the Board of Education on the suggestion of the Council of the Society of Arts, and the Chairman (Mr. Sidney Colvin) announced that next year an exhibition would be arranged at the British Museum of the unrivalled collection of mezzotints which the late Lord Cheylesmore bequeathed to the nation.

V.—Cantor Lectures.

The first course of Cantor Lectures for the current session was by Professor Vivian Lewes on "The Future of Coal Gas and Allied Illuminants." The Society has been indebted to Professor Lewes for many brilliant courses of lectures and papers on this subject, the value of which has always been attested by the large attendance of those connected with the industry which these lectures have always attracted. The first two lectures dealt for the most part with recent developments in gas manufacture, including the production of low grade gas and the use of cheaply produced gases for the dilution of coal gas. The third lecture dealt principally with the incandescent mantle, and the fourth with the new methods of lighting by gases produced from oil. A very striking experiment in this last lecture illustrated the value of the oil gas blowpipe, the power of which was so great that a hole was rapidly pierced by its use in thick iron plate.

The second course of lectures was a thoroughly practical one by Mr. Julius Hübner on "Paper Manufacture." This subject had been previously treated by Mr. William Arnot and Mr. C. F. Cross. Mr. Hübner brought the

subject up to date, and described the methods and materials used in the most recent processes of manufacture.

Professor J. A. Fleming's course on "Hertzian Wave Telegraphy" was one of the most attractive and interesting which has ever been delivered in the Society's theatre. This course of lectures formed the best popular description of wireless telegraphy in principle and in practice that has yet been published. Professor Fleming is a strong advocate of the Marconi system, and his relations with the Marconi Company enabled him to carry out for the purpose of illustrating his lectures a very striking series of experimental tests demonstrating the non-interference of the currents used in Trans-Atlantic telegraphy with those for communication over a shorter distance, and, in the lecturer's opinion, demonstrating the value of the syntonic system of Mr. Marconi. The lectures attracted large and interested audiences.

The popular subject of Automobiles formed the subject of Mr. W. Worby Beaumont's course on "Mechanical Road Vehicles." Eight years ago, when the motor was first coming into public notice, Mr. Beaumont gave an interesting course of lectures on the same subject. Now that it has become popular he was able to go much further into the details of construction, and to describe the principal types of motors now coming into general use.

VI.—Juvenile Lectures.

The course of Juvenile Lectures for the present year was delivered by Professor Edward B. Poulton, who, in 1891, gave an interesting course on "Mimicry in Animals." This year, Professor Poulton further developed the same subject, and showed how mimicry was employed as the "Means of Defence in the Struggle for Life among Animals." In two very interesting lectures, fully illustrated by colour and other photographs, the lecturer demonstrated the methods by which animals deceive their enemies and their prey by imitating either their own environment, or other animals of a more noxious or offensive nature.

VII.—Albert Medal.

The Albert Medal for the year 1903 has, with the approval of His Royal Highness the Prince of Wales, President of the Society, been awarded to Sir Charles Augustus Hartley, K.C.M.G., "in recognition of his services, extending over 44 years, as Engineer to the International Commission of the Danube, which have resulted in the opening up of the navigation of that river to ships of all nations, and of his similar services, extending over 20 years, as British Commissioner on the International Technical Commission of the Suez Canal."

Sir Charles Hartley has executed a work of European importance, viz., the opening up of the Danube for the shipping of all nations, somewhat in the same way as Mr. Eads opened up the Mississipi, though by different means. The circumstances of his work are peculiar, and the success of his achievement is perhaps not so widely known as it deserves to be. An International Commission was appointed soon after the Crimean War, on which every nation in Europe was represented, and Sir Charles (then Captain) Hartley was nominated Engineer-in-Chief. The mode of improving the Danube was a subject on which much difference of opinion existed, as there were three mouths to the river and each had its advocates. Sir Charles Hartley chose the Sulina mouth, and by the careful study of the question which he made, and by his absolute singleness of purpose, he conciliated all opponents, and has from his first appointment to the present time gained and enjoyed the complete confidence of the International Commission. His work has been a complete success, and the measure of the improvements effected can be known through the technical descriptions which from time to time have been published. At the Engineering Congress at Glasgow, in 1901, an important paper set out the history of the improvements of the Danube. The paper in question was contributed by Mr. Kühl, who a few years ago succeeded to Sir Charles Hartley as Executive Engineer on his retirement from that post. Sir Charles was then requested to accept the post of Consulting Engineer to the Commission, which office he still holds, and nothing of importance is done without his approval. Sir Charles Hartley has filled other very important posts. He has for some 25 years been one of the two English representatives on the International Technical Commission of the Suez Canal. He was appointed umpire in the inquiry into the pollution of the Thames in the dispute which had arisen between the Thames Conservancy and the Metropolitan Board of Works. He was appointed by Government one of a small Commission on the River Ribble, and he was, with Sir John Wolfe-Barry, appointed by the Government of Natal in connection with the important works for the improvement of

Durban Harbour. He has, of course, done much other work, but the above stand out as conspicuously important services. It may also be interesting to recall the fact that he efficiently supported Mr. Eads in his proposals for improving the Mississipi, when that engineer was contending almost single-handed against a great adverse weight of professional opinion in Ameria, and Mr. Eads cordially recognised the help which Sir Charles Hartley's position and experience afforded him at the crisis of his career.

VIII.—Medals.

The Council have awarded the Society's Silver Medal for the following papers read during the session 1902-3:—

At the Ordinary Meetings:—

To Dr. Gustave Goegg, for his paper on "Le Tunnel du Simplon, et la nouvelle ligne de Chemin de fer directe Anglo-Italienne pour l'Orient."

To Archibald P. Head, Mem.Inst.C.E., for his paper on "The South Russian Iron Industry."

To Prof. W. Smart, LL.D., for his paper on "Industrial Trusts."

To Dr. Benedict W. Ginsburg, for his paper on "The Port of London."

To Alfred C. Eborall, M.I.E.E., for his paper on "Application of Polyphase Motors to the Electrical Driving of Workshops and Factories."

To Gabriel J. Morrison, for his paper on "The Construction of Maps and Charts."

To E. North Buxton, for his paper on "Preservation of Big Game in Africa."

To Egerton Castle, for his paper on "Swordsmanship considered Historically and as a Sport."

In the Indian Section:—

To Miss Ella C. Sykes, for her paper on "Domestic Life in Persia."

To Sir Charles James Lyall, K.C.S.I., M.A., LL.D., for his paper on "The Province of Assam."

In the Colonial Section:—

To The Countess of Aberdeen, for her paper on "Women in Canada."

To Herbert Samuel, M.P., for his paper on "The Uganda of To-day."

In the Applied Art Section:—

To G. F. Bodley, R.A., for his paper on "Some Principles that may be Guides for the Applied Arts."

To Miss Hannah Falcke, for her paper on "Artistic Fans."

The Committee of the Council on Medals reported that in their opinion it was undesirable to award a medal for any paper the author of which had previously received a medal, and this advice was adopted by the Council.

IX.—Owen Jones Prizes.

After the death, in 1874, of Owen Jones, a committee was formed to collect subscriptions for the purpose of founding a memorial. The money thus obtained was partly expended in erecting a monument over his grave in Kensal Green, and the balance (a sum of £400) was presented to the Council of the Society of Arts upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in actual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes have now been awarded annually since the year 1878 on the results of the annual competition of the Science and Art Department.

Six prizes were awarded this Session, each prize consisting, in accordance with the regulations laid down for the administration of the Trust, of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The list of the successful candidates has already appeared in the *Journal*.*

The next award will be made this summer, on the result of the present year's examinations. Six prizes have again been offered for competition.

X.—Shaw Prize.

In January, 1902, the Council offered under the terms of the Benjamin Shaw Trust a Gold Medal, or a Prize of £20, for improvements in Industrial Hygiene. Intending competitors were asked to send in descriptions of their inventions by the 1st of May, last year. By that date 43 applications were received. These were referred by the Council to a Committee, and as the result of their deliberations, the Prize was awarded to Mr. James Tonge, jun., of Westhoughton, Lancashire, for his Hydraulic Mining Cartridge, an appliance for breaking down coal in mines without the use of explosives. The Committee in their report pointed out that it had been frequently proposed to use some kind of hydraulic apparatus for this purpose, and that they were aware of instances in which such apparatus had been successfully tried. They were, however, satisfied that Mr. Tonge's Hydraulic Cartridge had been successfully used in several mines, where it had superseded the use of explosives. A description of the apparatus will be found in the *Journal* for September 5th, 1902, page 805.

* See *Journal*, vol. l. p. 753, August 8, 1902.

XI.—Fothergill Prize.

It was mentioned in the last report that a prize of fifty pounds and a silver medal had been offered under this Trust for a paper on "Existing Laws, By-laws, and Regulations relating to Protection from Fire, with Criticisms and Suggestions." The paper was to be written with a view to its being read and discussed at one of the Society's meetings, and competitors were requested to send in not later than the 1st October, 1902.

In accordance with the recommendations of the Committee, to whom the matter was referred by the Council, this prize was awarded to Mr. T. Brice Phillips, of Uckfield, Sussex. But having regard to the merits of the papers sent in, the Committee recommended that two additional prizes should be given, and in accordance with their recommendation the Council awarded a prize of ten pounds to Mr. George H. Paul, and a similar prize to Dr. W. Craig Henderson, while announcing that the paper sent in by Captain Arthur Shean was worthy of honourable mention.

At the Ordinary meeting of the Society held on the 11th of March last the prize essay was read *in extenso*, and the two essays to which second prizes had been awarded were read in abstract.

XII.—Mulready Prize.

Under this Trust a Mulready Medal is presented occasionally, as the accumulated funds permit, to the student who should exhibit the best drawing from the nude at the annual examinations of the Board of Education.

The Medal has been awarded on several occasions, the last occasion being in 1897. It has been offered for competition amongst students of Schools of Art in the United Kingdom, at the annual competition for the present year. The result will be announced as soon as the adjudication has been made by the Board's examiners.

XIII.—Prizes for Drawing.

Since 1899, the Council have placed at the disposal of the Royal Drawing Society, for competition among the candidates at its annual examination, 12 Bronze Medals, and, as usual, these medals were awarded for drawings sent in by students to the exhibition held by the Drawing Society in April last.

XIV.—Fire Prevention Prizes.

The Executive Committee of the International Fire Prevention Exhibition, which is now open at Earl's Court, made a request to the Council of the Society that they would further the ends of the Exhibition by offering certain prizes for apparatus in connection with the prevention of fire, and the Council decided to devote some of the funds available under the Fothergill Trust to this purpose.

This Trust arose out of a bequest by Dr. Fothergill, in 1821, "for the establishment of premiums for promoting useful arts." The objects which the testator proposed to the Society for consideration all related to the prevention of fire, and the Council have therefore considered it desirable to retain the connection of the Trust with fire prevention, although the bequest was not really limited to this special purpose. They, therefore, felt themselves justified in acceding to the proposition of the Committee of the Exhibition, and decided to offer two gold, and certain other, medals for the best Chemical Fire Engines, and the most easily worked Long Ladders exhibited at the Exhibition. These medals will be awarded by the Council on the report of the Judges, who may be appointed by the Executive of the Exhibition.

XV.—Swiney Prize.

This prize will have to be awarded in January next, on the sixtieth anniversary of the testator's death. Dr. Swiney died in 1844, and in his will he left a sum of £5,000 Consols to the Society for the purpose of presenting a prize on every fifth anniversary of the testator's death to the author of the best published work on Jurisprudence. The award is made jointly by the Society of Arts and the College of Physicians. On the occasion of the first award being made, the question was discussed between the two bodies concerned as to what share should be allotted to Medical Jurisprudence, and an arrangement was arrived at that the award should be made alternately to Medical and to General Jurisprudence. This plan has been continuously followed. On several occasions the question of revising the arrangement has been considered, but after consideration it was determined that there appeared to be no reason to disturb an arrangement which had worked well for the past 50 years, and that it should be continued, with the understanding that if at any time the joint Committee of the Society of Arts and the College of Physicians, which was usually appointed to submit a book to the adjudicators, should be unable to find a work of the class whose turn it was to receive the award, which appeared to them to be of sufficient merit,

ey should be at liberty to recommend a book longing to the other class. On the last casion of the award, in 1899, the prize was warded for Medical Jurisprudence. It will, erefore, be offered on the present occasion r General Jurisprudence, and the Council ll be glad to receive any suggestions which embers of the Society, or others, may care send in as to suitable works for the purpose.

XVI.—Prize for Dust-arresting Respirator.

In the early part of the year a suggestion as made to the Council that the Society of rts might offer a prize for a respirator itended to arrest dust in the various industrial rocesses in which the health of the workeople suffers from their being forced to reathe a dusty atmosphere. After due conideration, the Council determined to offer nder the Benjamin Shaw Trust a prize of a old Medal, or £20, for the best Dust-arresting Respirator for use in dusty processes and n dangerous trades.

In publishing this offer the Council reerred to the fact that for many years ast the necessity for such an apparatus has een recognised. As far back as 1822 the ociety awarded its Gold Medal to Mr. J. H. braham, of Sheffield, for a Magnetic Guard o protect persons employed in dry grinding. The apparatus described in the Society's 'Transactions" (Vol. 40, 1822, page 135) ncludes a Respirator to cover the mouth and ose. This Respirator was fitted with magnets, or the purpose of arresting the fine particles f steel thrown off in the process of pointing eedles, and in other processes of dry grinding. Although the invention was greatly appreciated t the time, it appears never to have come into ractical use, the main objection to it having een, it is believed, raised by the workpeople hemselves, who feared that the lessened risk ttached to their employment would lower their ages. Similar considerations have, it is elieved, stood in the way of the introduction of arious appliances intended to lessen the risks ssociated with all trades in which the workeople breathe a dusty atmosphere. The Council, however, think that such consideraions are likely to have less weight at the resent time, and they hope that the offer of a rize may draw the attention of inventors to the atter, so that it may result in the production f some suitable piece of apparatus, despite the ifficulties with which the solution of the roblem is surrounded.

The conditions which the apparatus will be required to fulfil were stated in the *Journal* (May 1, 1903, p. 553), and it was announced that the competition would be open until the 31st of December of the current year, by which time intending competitors are required to send in specimens of their inventions.

XVII.—Examinations.

It is gratifying to be able to report that the entries for the Society's examinations, which have been steadily growing in numbers for many years, show a greater proportionate increase than ever. For the examinations held in March and April last, no less that 19,367 entries were received—12,758 in the ordinary grade, and 6,609 in the elementary. The total increase this year is 3,023, the entries last year being 16,344, of which 11,058 were in the ordinary, and 5,286 in the elementary grade. During the past ten years the numbers have more than quadrupled, for in 1893 there were 4,160 entries. As a rule, about 9 per cent. of those entering fail to present themselves for examination. The reason for this large abstention it is a little difficult to understand. For the present year the percentage is rather smaller, about 8 per cent. having failed to come up. The actual number of papers worked was in Grade II. (General) 11,682, and in Grade I. (Elementary) 6,021. It is to be understood that many candidates entered for more than one subject, the actual number of candidates being in Grade II. about 10,622, and in Grade I. about 5,460.*

The following Table shows the general results in Grade II. for the last eleven years :—

Year.	No. of Candidates.	No. of Papers worked.	No. of Centres.	No. of Subjects.
1893........	3,702	3,916	109	13
1894........	4,106	4,376	131	14
1895........	4,777	5,108	146	14
1896........	6,111	6,568	197	16
1897........	6,919	7,513	221	19
1898........	7,636	8,372	243	19
1899........	8,750	9,581	260	23
1900........	8,894	9,808	267	23
1901........	8,797	9,669	276	19
1902........	9,020	9,967	289	19
1903	10,622*	11,682	322	19

* The precise figures are not yet available. Those given may be taken as a very close approximation.

Another satisfactory point may be noted in the Table, and that is the increase in the number of Centres—there are now 323, or nearly three times as many as in the year 1893. Including those centres which only took Grade I. papers, the total number is now 344.

Though it is a little difficult to estimate with accuracy the standards for the various classes, it may be taken as fairly certain that the general standard steadily tends to rise. The percentage of first-class candidates shows a steady increase, that of the second-class varies from year to year; and the same be said of the third-class; but there is a regular diminution in the number of failures, Coming to exact figures, the percentage of the first-class is this year 14, last year it was 13·5, and the year before 11. The corresponding figures for the second-class are 23·9, 27, and 22·2; for the third-class 39·8, 34, and 40; and for the failures 22·3, 25·5, and 26·4. A little uncertainty is introduced into the estimate as between the years 1901 and 1902, because the standard for the first-class certificate was lowered in the latter year from 75 to 70; but as regards the present and the previous year the standard was the same and the figures, therefore, admit of accurate comparison. Due allowance must also be made for the fact that the papers from year to year must of necessity vary somewhat in difficulty, and the marking of the examiners cannot always be absolutely the same. It is, therefore, only a general estimate that can be safely arrived at from the figures given; but it may be taken as certain that the standard of quality of the candidates entering for the examinations have of late years been steadily, though slowly, improving.

The numbers given above for Grade II. include the papers worked in Music, of which there were in all 464. Deducting these from the 11,682 papers worked in Grade II., we get 11,218 in strictly commercial subjects. This is an increase of 1,828 on the corresponding number of similar papers last year.

It may be taken as a satisfactory sign that this increase is spread over almost the whole range of subjects. Commercial Geography shows a falling off — 89 candidates as compared with 114—and for Italian there were only 10 candidates this year as compared with 21 last. In two other of the modern languages —Russian and Danish—in which of recent years a few candidates have presented themselves, there is a slight decrease. Last year there were 7 for Russian and 7 for Danish; this year there are only 5 in Russian and 1 in Danish.

All the other subjects show an increas The greatest increase is in Book-keeping, which no less than 4,538 candidates we examined this year as compared with 3,7 last. The next largest increase is in Sho hand—3,697 compared with 3,100. The have always been the two most popular su jects. Typewriting also shows a considerab increase—873 against 795. Also the mode languages, except those above mentione show larger numbers this year—for Fren there were 770, as compared with 544; f German 327 against 270. In Spanish t numbers are practically stationary, as there only one more candidate this year—171 again 170. 40 entered for Portuguese this year, a 33 last. In Arithmetic there were 285, la year there were 222. In English the numbe are 260 and 199; in Economics, 77 and 5 Précis-writing, 75 and 55.

Last year the number of students enteri for the modern language examinations show a slight falling off, and this was noted as matter for regret in the report. It is, ther fore, satisfactory to see that this falling off not continued, but that the numbers in som cases are in excess of those of two years bac

Considering the subjects in a little mo detail, and the examiners' reports upon the we find that taking the numbers who entere for the last five years in Book-keeping, t increase upon the lowest previous return 862, and upon the highest 532. Of the 4,5 candidates who entered, 84·82 per cent. passe and 15·18 failed, the percentages of the class taken being first-class 21·75, second 30·0 and third 33·05. Comparing these resul generally with those of recent years, it appea that the percentage of first-class still grow and the percentage of failures has bee gradually decreasing from 31·68 per cent. 1899 to 15·18 per cent. this year. This all, the examiner remarks, points to continue improvement. It may be added that thoug the percentage of first-class is the highest t examiner has had yet to record, he notes a absence of the very exceptional merit in the to places which characterised last year's result

In Typewriting the number of first-clas candidates is less than last year, the percen tage of first-class being 5·3, whereas la year it was 7·5, and 8 the previous year. Th percentage of failures is about 23.

The examiner in Shorthand reports favou ab'y on the general results, the standar attained by the candidates in each stag showing a decided improvement on pre

ling years. The percentage of first-class ndidates, never very great, is a little ger this year than last. Nearly 6 per nt. obtained firsts this year, whereas last ar there were barely 2·5. The percentage absolute failure is small, about 16, while a ge proportion take third-class, viz., 46 per nt.

In Arithmetic the work of the candidates pears to have been on the whole good. The rcentage of first-class candidates is 5·6, that the failures is about 20·3.

The examiner in Précis-writing states that e general result is more satisfactory than it s been on former occasions. The work, as a le, was better done, though there was still nsiderable fault to be found with the work of any of those who entered.

The examiner in English considers that the apers this year were fully up to the average andard.

As regards Commercial Geography, the fact as already been noted that the number of andidates showed a considerable falling off s compared with the last two years, and it is lso unsatisfactory to have to report that in the pinion of the examiner there was very little ally first-class work sent in. On the other and a great majority of the candidates showed igns of intelligent preparation, and there were w failures. The subject of Commercial Geo-raphy is one of very great importance, and he numbers entering for it have of late years hown a considerable increase. It is a matter or regret that there should be any falling off ither in the number entering or the character f their work. It may be mentioned that the ouncil have adopted a suggestion put forward y Mr. G. G. Chisholm, the Examiner, that in uture the subject shall be not Commercial eography alone, but Commercial Geography nd History.

As already mentioned, the number of candi-lates entering for the various examinations in nodern languages shows a very satisfactory ncrease, though it seems a pity that more ttention should not be given to those langu-ges which are less commonly studied—Russian, Danish, Chinese, and Japanese. No andidates ever enter for the two last named. t may be interesting to mention in this con-ection that an Army Order recently issued uthorises the making of a special allowance o officers who qualify themselves in Japanese, nd also that a Professor in this language has ately been appointed at King's College. It nay, therefore, result that further attention will be drawn to the study of Japanese, and possibly some of the students may be attracted to the examinations in this language which the Society has so often offered, without it must be admitted any success up to the present.

The French examiner reports satisfactorily on the results of his examination, and states that many of the best papers were quite brilliant. In the case of German, the ex-aminer notes a considerable decrease in the number of first-class certificates, and a very large increase in the number of third-class. There were certainly not so many really brilliant papers sent in this year, but he ex-presses himself as quite satisfied with the general results. The Spanish examiner says that considering the high standard of the paper the results of the examination are satis-factory; and the examiners in Italian and Portuguese express themselves to much the same effect.

No application has yet been made for any of the Certificates of Proficiency in Commercial Knowledge which have been offered during the past two years to any candidate who has passed in five specified subjects within a period of three years.

The Society's musical examinations are con-ducted under precisely the same regulations and conditions as those of the general exami-nation (Grade II.). The examination is divided into two parts—(1) Rudiments of Music, (2) Harmony—and for some years past two classes of certificates, namely Elementary and Higher, were given in each division. Last year a third grade was introduced in the Harmony exami-nation, intermediate between the Elementary and Higher grades. In the Elementary grade of Rudiments of Music 179 candidates entered, of whom 150 passed and 29 failed. Of those who passed, 75 obtained 90 or more of the maximum marks (100). For the Higher grade 123 candidates entered, of whom 96 passed and 27 failed; 40 obtained 90 or more marks. In Harmony 91 candidates entered for the Elementary grade—67 passed, of whom 28 obtained 90 or more marks, while 24 failed. For the Intermediate only 27 entered, of whom 20 passed and 7 failed. Forty-four entered for the Higher grade—30 passed and 14 failed. On the whole the examiner regards the results as satisfactory, though he expresses a hope that in future years a larger number of candi-dates may be attracted to the Intermediate grade in Harmony.

With regard to Grade I., this year about 5,460

candidates came up for examination, as compared with 4,371 last year. These candidates worked 6,021 papers, the corresponding number last year being 4,807. The following Table shows the number of candidates who passed or failed in each subject:—

Subjects.	No. of papers worked.	Passed.	Failed.
Handwriting and Correspondence	367	164	203
Shorthand	1,642	1,106	536
Book-keeping	1,684	1,017	667
Commercial Arithmetic	584	369	215
Commercial History & Geography	68	34	34
French	660	397	263
German	284	192	92
Typewriting	732	398	334
Totals ..	6,021	3,677	2,344

Comparing the results with last year, it is gratifying to notice that in every subject there is an increase. The most popular subjects are Shorthand and Book-keeping—in Book-keeping there was an increase of 177; in Shorthand an increase of 188. The greatest proportional increase was in Typewriting, which has risen from 471 to 732.

Comparing the percentages of results with last year, it appears that whereas last year 62·7 candidates passed and 37·3 failed, this year only 61 per cent. have passed and 39 failed. This difference must not in all probability be attributed to any alteration in the standard of the candidates, but to an effort on the part of the examiners slightly to raise the standard of the whole examination. While an endeavour will always be made to preserve the elementary character of the examination, it is possible that it may be found desirable to raise the standard for a pass a little, but not much, above what is now considered sufficient.

Three Certificates in Elementary Commercial Knowledge were issued in 1902 to candidates who had passed in the four specified subjects.

With regard to one of these, the candidate had qualified in one subject in Grade II., and it was resolved that in future a pass in that grade might be counted toward the Elementary Certificate.

At the date of the last General Meeting the results of the 1902 examinations were not fully known. It may, therefore, be interesting to record here that in that examination the largest number of candidates sent up by a[n] institution came from the London Scho[ol] Board, which sent up 1,584 candidates, [of] whom 1,151 passed. No less than 5 of the [...] medals offered by the Society among the fir[st] class candidates were taken by students of t[he] London School Board. Pitman's Metropolit[an] School had the same number of medallist[s,] the City of London College sent up 4, t[he] Cusack Institute 3, the Manchester Scho[ol] Board 3, the Birkbeck Institution 2, t[he] Battersea Polytechnic 2, and the Birmingha[m] and Midland Institute 2.

XVIII.—Viva Voce Examinations [in] Modern Languages.

These examinations, which were establish[ed] last year, have proved extremely successf[ul.] Up to the present date 14 examinations ha[ve] been held this year in London and in Ma[n]chester, and arrangements have also be[en] made for holding examinations at 4 of t[he] London School Board Evening Schools [in] French, and at the Merchant Venturer[s'] Technical College, Bristol, in French a[nd] in German.

The following Table gives the results of t[he] examinations which have already been held:-

	No. of Candidates.	Passed.	Failed.
French........	166	123	43
German	84	52	32
Spanish	19	13	6
Portuguese	20	18	2
	289	206	83

In 1902, 280 candidates were examined i[n] all, of whom 202 passed and 78 failed.

These examinations are held at any of th[e] Society's centres where the necessary arrange[-]ments can be made. They are held at an[y] date convenient to the local committee. Th[e] examination includes dictation, reading, an[d] conversation, and the examination is s[o] arranged as to test efficiency in a colloquia[l] knowledge of the language, without laying to[o] much stress on minute grammatical accuracy[.] Amongst the candidates who presented them[-]selves were many who showed a very consider[-]able knowledge of the language, and it wa[s] thought only proper that some differenc[e] should be made between them and candidate[s] only showing a moderate knowledge. The Council therefore decided that those candi[-]

ates who were reported upon as highly qualified by the examiners, should receive a certificate of having passed with distinction. During the present year 46 candidates have in all been awarded such certificates, 28 in French, 11 in German, 5 in Spanish, and 2 in Portuguese. It may be taken that any person holding one of these certificates has a knowledge of the language which would qualify him to undertake the work of a commercial traveller, or agent, in the country where the language is spoken for which his certificate is granted. Any candidate who has taken a pass certificate may be considered to possess a knowledge of the foreign language which would enable him with a little practice to undertake work of the same character.

XIX.—Practical Examinations in Music, 1902.

The Practical Examinations in Music for 1902 were not concluded last year until the 12th July, too late for the results to be included in the last Report of the Council. The date was a little later than usual on account of the time fixed for the Coronation. The results were published in the *Journal*.* The examination lasted for 8 days, and was conducted by Mr. Ernest Walker, M.A., Mus. Doc. Oxon., and Mr. Burnham Horner.

The system of examination was the same as that which has now been in force since 1896. For instrumental music certain standards are given, and candidates are asked to select for themselves in which of these standards they choose to be examined. The standards range from easy to very difficult music. For each standard a list of music is given for study, and the candidates are required to select from this list two pieces which they have to sing or play to the examiner. In the third and fourth standards they have also to play a piece, or a portion of a piece, at sight.

In all, 413 candidates entered, and of these 397 were examined, a decrease of 153 as compared with the previous year; 3 of these took up two subjects, so that there were 400 examinations. Of these there were 336 passes and 64 failures.

The following were the subjects taken up:—Piano, singing, violin, violoncello, and organ. 308 entered for the piano, 256 of whom passed, and 2 obtained medals; 61 entered for the violin, of whom 54 passed; 2 entered for the violoncello, 1 of whom passed; 5 entered and 4 passed for the organ, and 2 obtained medals; 24 entered for singing, of whom 21 passed, 2 obtaining medals.

Entries for the guitar, mandolin, &c., which had previously been received, were not accepted last year, nor will they be in future.

XX.—Practical Examinations in Music, 1903.

The Practical Examinations for the present year have not yet been concluded. They only commenced on Monday, June 22nd. They will be finished about July 4th, after which a summary of the results will be given in the *Journal*. The work of the examination is being carried out by the same examiners as in the last two years. 498 candidates have entered for the present examinations, an increase on last year of 85, though the numbers do not equal those of the year 1901, when there were 566 entries.

XXI.—Leather for Bookbinding.

The work of the Committee on Leather for Bookbinding was referred to in the report of the Council read at the Annual Meeting in 1901. This Committee have resumed their labours, and hope shortly to be able to issue an extended and revised edition of their original report, with considerable additions and with coloured illustrations showing the effect of light and other injurious agencies upon leather. In the preparation of this work, which it is expected will be a matter of some cost, the Society are promised the assistance of the Worshipful Company of Leathersellers, who have liberally undertaken to provide funds which it is believed will suffice to cover the estimated expenses.

XXII.—Municipal Trading.

In consequence of some suggestions which were made at the meeting when Mr. Dixon Davies's paper on Municipal Trading was read, the Council addressed a Memorial to the Prime Minister asking for the appointment of a Royal Commission to consider the question. The memorial urged that certain definite principles should be laid down as to the class of undertaking upon which municipalities should enter, and asked for an independent, impartial, and authoritative enquiry, such as could be conducted by a Royal Commission alone, which in addition to ascertaining and recording facts, might lay down the principles and limitations under which Parliamentary

* See *Journal*, vol. l. p. 803, September 5, 1902.

powers should be granted to municipal and local authorities. The text of the memorial will be found in the *Journal* for April 3rd, page 463.

In answer to this Mr. Balfour referred to the debate on the question which took place in the House of Commons on Wednesday, April 22nd, and to his own announcement of the intention of the Government to appoint a Parliamentary Committee on the subject.

A Joint Committee of both Houses has since been appointed, and is now sitting.

XXIII.—Journal.

The volume of the *Journal* which ended in November last was the fiftieth of the series, and it will consequently be necessary to issue another ten-volume index. Such an index is now in course of preparation, and will shortly be issued. The four previous indexes are in print, and can be obtained by the members.

A year ago a new arrangement was made about the advertisements in the *Journal*, and the Council transferred the agency for them to Messrs. Walter Judd, Limited. The new arrangement appears to be working extremely well, and it is hoped that the advertisements may prove a larger source of revenue to the Society than they have been of late years. The value of the *Journal* as an advertisement medium with its large and important circulation, cannot be doubted, and any profits from this source must be welcomed as helping to reduce the very heavy cost of the *Journal*.

XXIV.—Conversazione.

The Society's annual Conversazione will be held on Tuesday, the 30th inst., for the third time at the gardens of the Royal Botanic Society. Both in 1901 and in 1902 these entertainments were very successful, and were much enjoyed by the members. It is hoped that the Conversazione for the present year may be as well attended, and as greatly appreciated, as its two predecessors. The arrangements, full particulars of which have been given in the *Journal*, are of the usual character.

XXV.—Exhibition of Engravings.

The Exhibition of Etching and Engraving, which, as mentioned in the last report of the Council, the Board of Education had undertaken to hold at the initiative of the Council of the Society, was opened on the 14th of May last, and comprises a fine representative collection of engravings, etchings, and mezzotints from the earliest date down to the present tin This is the third of a series of exhi tions of the graphic arts arranged by t Board, the first having been the one of lit graphy, held in 1898, and the second the o of modern illustration, held in 1900. T Council hope that the Board of Education w next, or in some future year, complete t series in accordance with the Council's su gestion, by holding an exhibition of pho gravure, and other kindred processes. T original proposal of the Society was th the present exhibition should include e graving and photogravure, but the Adviso Committee, to whom the proposal was referre considered the scope too wide for a sing exhibition, and, therefore, recommended t Board to confine the present exhibition engraving and etching alone, deferring to later period the collection of works execut by processes of photogravure.

XXVI.—New Council.

In accordance with the provisions of the B laws four Vice-Presidents and four Membe of Council have to retire. The retiring Vic Presidents are Lord Avebury, Sir Steua Colvin Bayley, Sir Edwin Durning-Lawrenc and Dr. Ludwig Mond. In their places th Council propose for election the Lord Chance lor, Lord Kelvin, Sir William H. Preece, an the Lord Mayor of London. The Lord Chance lor and Lord Kelvin have both served on th Council on previous occasions. The preser Lord Mayor, Sir Marcus Samuel, has not. S William Preece has served for the past fou years as a Member of the Council, from whic he retires. The other retiring Members of th Council are Sir George T. Livesey, Sir Walte Peace, and Sir John I. Thornycroft. In the places the Council now propose Mr. Henry H Cunynghame, C.B., Sir Robert Giffen, Lor Harris, and Sir Thomas Holditch. With th exception of Sir Robert Giffen none of thes gentlemen have before acted on the Society' Council.

XXVII.—Obituary.

During the past year two eminent member of the Council have passed away—Sir Frederic Abel and Sir William Roberts-Austen. Si Frederick Abel had served on the Counci almost continuously since 1868, and from 188 to 1885 he acted as its Chairman. Few of its members have rendered more valuable service to the Society than Sir Frederick Abel, wh was a constant attendant at the meetings o

Society itself, of the Council, and of its nmittees. Sir William Roberts-Austen, ugh his connection with the Society did not end over so many years as that of Sir derick Abel, took a keen interest in the iety and its work. In the long series of ntor lectures those which he delivered are ong the most important, and remain a ord of work of the most valuable character, vork also which would certainly have been ntinued had his life not been cut short.

)r. J. H. Gladstone served on several Comttees, and read several valuable papers bee the Society. The Archbishop of Canterry was a very old member of the Society, d was at one time intimately connected with examinations. He was one of the original aminers appointed by the Council in 1856, s subject being English History. This work continued for 13 years.

Mr. Edward Woods, one of the oldest memrs of the Institution of Civil Engineers was so one of the oldest members of the Society, ıich he joined in 1853.

Dr. Andrew Common, the distinguished tronomer, joined the Society in 1885.

Mr. J. I. Tracy was a member of nearly fifty ars' standing, and was a frequent attendant the meetings. Mr. J. Hungerford Pollen ıs an active member of the Committee of the pplied Art Section, gave a course of Cantor ctures in 1885, and read several papers. ›rd Pirbright had been a member of the ›ciety since 1857. Field-Marshal Sir J. ntorn Simmons was elected in 1853. Mr. orace Bell was a member of the Indian Secon Committee, and contributed two papers on ıdian railways. Sir James Westland also took ırt in the proceedings of the Indian Section. Obituary notices have also appeared in the *ournal* of Sir Alexander Mackenzie, the ev. Dr. Wiltshire, Mr. J. Dunn-Gardner, r. Thomas Ward, the Rev. W. B. Galloway, r. A. F. Osler, F.R.S., and Mr. Richard arsden.

Colonel Hardy was not a member of the ›ciety, but he acted as secretary of the ıdian Section from 1873 to 1884.

XXVIII.—FINANCE.

The annual statement of receipts and exenditure was published—in accordance with ıe usual practice—in the *Journal* last week. shows the revenue and expenditure for the nancial year ending May 31st last, the Assets nd Liabilities of the Society, its Investments nd the Trusts standing in its name.

DISCUSSION.

The CHAIRMAN (Sir Owen Tudor Burne, who took the chair on Sir William Preece having left to fulfil an engagement) moved the adoption of the report, and said he felt sure the members would be satisfied with the quality of the work which had been done and the progress the Society had made during the year. He considered the standard of the papers and lectures delivered during the past session to be unusually high, and he thought those papers read before the Indian, Colonial, and Applied Art Sections by ladies were specially interesting. As regards the examinations, he thought it was most satisfactory that whilst the numbers of the candidates entering had more than quadrupled during the past ten years, the standard and excellence of their work was higher at the present time than it was a few years ago. He knew from personal experience that the Society's certificates and prizes were greatly valued. The Society had sustained many losses through death which they deplored, but its work still went on, and he hoped that it would continue to go on for many years to come, as he felt sure the Society was filling a place in the country of extreme value and importance.

Sir EDWIN DURNING-LAWRENCE, Bart., M.P., in seconding the adoption of the Report, agreed with what the Chairman had said as to the value of the Society's work during the past year. The time had long gone by since philosophers had abandoned the dictum of Socrates that knowledge was to be acquired by introspection. True knowledge was the result of observation, and one of the great exponents of practical knowledge was the Society of Arts. Our present civilisation was the result of mechanical and scientific progress, and this progress, again, was largely due to our Society.

Mr. W. MARTIN WOOD supported the motion, but said he felt inclined to dissent from the Chairman's opinion as to the level of the papers being higher than usual. He fully admitted, however, that the courses of Cantor lectures this session had been of an exceptionally high character. As regards the general action of the Society, he thought the Council had been ill-advised in taking an active part in a partisan agitation by presenting a Memorial to the Prime Minister for the appointment of a Royal Commission on Municipal Trading. He would ask the Society to consider the question of taking up the subject of Water Communications and Inland Navigation. It was really one of the most urgent needs of the country, and although great strides in this method of transportation had been made on the Continent, nothing was being done here. The Society had held a Conference on Canals and Inland Navigation in 1888, the records of which were available, and he hoped, having regard to the urgency and

importance of the subject, that the Council would take the matter into consideration. He was gratified to see the continued increase in the examinations, and hoped that they would be extended, as he felt sure the examinations enabled the Society to keep in touch with the provinces.

The adoption of the Report was then agreed to.

The CHAIRMAN moved a cordial vote of thanks to Sir Henry Trueman Wood (the Secretary), Mr. H. B. Wheatley (the Assistant Secretary), and the other officers of the Society, including Mr. S. Digby (the Secretary of the Indian and Colonial Sections), which was seconded by Sir WILLIAM LEE-WARNER, K.C S.I., and carried unanimously.

The SECRETARY, in returning thanks for this expression of confidence in himself and in the other officers of the Society, mentioned that the Society, at the conclusion of this meeting, would enter upon its 150th session. A hundred and fifty years was a long period, but he could claim to have been connected with the Society for a fifth of that time.

The ballot having remained open for one hour, and the Scrutineers having reported, the CHAIRMAN declared that the following had been elected to fill the several offices. The names in *italics* are those of members who have not, during the past year, filled the office to which they have been elected.

PRESIDENT.

H.R.H. the Prince of Wales, K.G.

VICE-PRESIDENTS.

H.R.H. the Duke of Connaught and Strathearn, K.G.	Michael Carteighe, F.C.S.
Duke of Abercorn, K.G., C.B.	Lewis Foreman Day
Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S.	Professor James Dewar, LL.D., F.R.S.
The Lord Chief Justice, G.C.M.G.	Hon. Sir Charles W. Fremantle, K.C.B.
Sir Benjamin Baker, K.C.M.G., F.R.S.	*The Lord Chancellor*
Sir George Birdwood, K.C.I.E., C.S.I., M.D., LL.D.	Henry Graham Harris
Sir Edward Birkbeck, Bart.	*Lord Kelvin, G.C.V.O., D.C.L., LL.D., F.R.S.*
Sir Frederick Bramwell, Bart., D.C.L., F.R.S.	Sir William Lee-Warner, K.C.S.I.
Major-Gen. Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.	Hon. Richard Clere Parsons
	Sir William Henry Preece, K.C.B., F.R.S.
	Sir Walter S. Prideaux
	Lord Rothschild
	The Lord Mayor (Sir Marcus Samuel)
	Sir John Wolfe-Barry, K.C.B., F.R.S.

ORDINARY MEMBERS OF COUNCIL.

Sir Mancherjee Merwanjee Bhownaggree, K.C.I.E., M.P.	*Sir Robert Giffe[n], K.C.B., LL.D., F.R[.S.]*
Sir Alexander R. Binnie.	Robert Kaye Gray
R. Brudenell Carter, F.R.C.S.	*Lord Harris, G.C.S[.I.], G.C.I.E.*
Henry Hardinge Samuel Cunynghame, C.B.	*Col. Sir Thomas Hung[er]ford Holdich, R.[E.], K.C.M.G., K.C.I.[E.], C.B.*
Professor Francis Elgar, LL.D., F.R.S.	Sir Westby B. Percev[al], K.C.M.G.
Professor Clement Le Neve Foster, D.Sc., F.R.S.	Alexander Siemens

TREASURERS.

Sir Owen Roberts, M.A., D.C.L., F.S.A.	Carmichael Thomas

SECRETARY.

Sir Henry Trueman Wood, M.A.

On the motion of the CHAIRMAN, a vote of than[ks] to the Scrutineers was carried unanimously.

Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., M.[D.], proposed a vote of thanks to Sir William H. Pree[ce] and to Sir Owen Tudor Burne for their services [in] the chair.

The motion was seconded by the Hon. RICHA[RD] CLERE PARSONS, and carried unanimously.

The CHAIRMAN, on behalf of Sir William Pree[ce] and himself, acknowledged the vote of thanks.

The meeting then adjourned.

MEETINGS FOR THE ENSUING WEE[K].

MONDAY, JUNE 29...National Indian Association, Jehang[ir] Hall, Imperial Institute, South Kensingto[n], S.W., 4½ p.m. Discussion on "Indian Studen[ts] in England; their Ideals and Difficulties."

TUESDAY, JUNE 30...Society of Arts' Conversazione at t[he] Botanic Society's Gardens, Regent's-park, 9 [to] 12 p.m.

Faraday Society, in the Rooms of the Chemic[al] Society, Burlington-house, Piccadilly, W., 8 p.[m.] 1. Mr. W. C. Dampier Whetham, "The Prese[nt] Position of the Theory of Electrolysis." Mr. Jam[es] Swinburne, "Chlorine Smelting, with Electr[o]lysis." 3. Dr. R. A. Lehfeldt, "Total and Fr[ee] Energy of the Lead Accumulator." 4. Dr. [F.] Mollwo Perkin, "Electrolytic Apparatus."

WEDNESDAY, JULY 1...Royal Archæological Institutio[n], 20, Hanover-square, W., 4 p.m. 1. Prof. [B.] Lewis, "Roman Epigraphy in North Italy." Mr. Harold Brakspear, "Roman Villa at Box."

FRIDAY, JULY 3—Art Workers' Guild, Clifford's-inn, Flee[t]-street, E.C., 8 p.m. Paper on "Masonry."

Journal of the Society of Arts,

No. 2,641. Vol. LI.

FRIDAY, JULY 3, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

The dates for the Examinations in 1904 (Grade I. Elementary, and Grade II. General) will be March 21, 22, 23, and 24. The last day for receiving entries will be February 24.

The results of the 1903 Examinations will be published next week.

The special subject for Commercial Geography (Grade II.) in 1904 will be "British India, Ceylon, and the Straits Settlements."

CONVERSAZIONE.

The Society's Annual Conversazione was held in the Gardens of the Royal Botanic Society, Inner Circle, Regent's-park, on Tuesday evening, 30th ult.

The reception was held by Sir William Preece, K.C.B., F.R.S., and the following Members of Council :—Major - General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I., Mr. Lewis Foreman Day, Sir Edward Durning-Lawrence, Bart., M.P., Professor Clement Le Neve Foster, F.R.S., Colonel Sir Thomas Holdich, R.E., K.C.M.G., K.C.I.E., C.B., Sir Owen Roberts, D.C.L., Mr. Alexander Siemens, Mr. Carmichael Thomas, and Sir John Wolfe Barry, K.C.B., F.R.S.

A Selection of Music was performed by the String Band of H.M. Scots Guards (Conductor Mr. Fred W. Wood) in the Conservatory, and by the Band of the Royal Engineers (Conductor, Lieut. J. Sommer, M.V.O.) in the Gardens.

A vocal and instrumental concert was given in the Club House by the Royal Criterion Bell Ringers and Glee Singers under the direction of Mr. Harry Tipper.

An Exhibition of Growing and Cut Roses and other Flowers were arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham Cross, and an Exhibition of Hardy Cut Flowers, by Messrs. Barr and Sons, of London and Surbiton, were on view in the Corridor, including a special display of Peonies and Irises.

A Collection of Japanese Dwarf Trees was also shown.

The number of visitors attending the Conversazione was 2,115.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday Afternoon, May 19, Sidney Colvin, M.A., in the chair.

The paper read was—

MEZZOTINTS.

By Cyril Davenport, F.S.A.

There are two distinct ways of engraving metal plates, so as to be able to make prints from them, the *intaglio* and the *relief*.

The intaglio forms of engraving comprise line engravings with the burin, dry point, and all forms of etching with acid.

The relief forms of engraving comprise such blocks as those cut for Pigouchet's "Books of Hours," in the 15th century, and those etched by William Blake for the cheap reproduction of his poems, in the 18th century. The first of these two kinds of engraving has been most used as far as metal is concerned, as wood is easier and cheaper to make for relief blocks.

To print from a metal plate, engraved in the intaglio manner, a strong pressure is required, but to print from a relief block only a slight pressure is required, and in either case an impression can be made either in white or in black, according to the manner in which the intaglio or the relief block is inked and printed.

A mezzotinted metal plate is at first clearly an intaglio, but as the rocking proceeds and becomes closer, the resulting burrs are actually raised above the level of the normal surface, and to that extent the plate becomes a relief block. Like a relief block also it will print black, and as the surface is scraped away or burnished down, so also the resulting effect on the print is towards white.

The difference of the commoner lines made

on a metal plate for the purpose of reproduction by printing shows clearly on one of my diagrams (Fig. 1). The upper line is a clear cut out of the surface of the metal, a thread of corresponding size to the cut being removed. The next line shows the effect of an etched

FIG. 1.

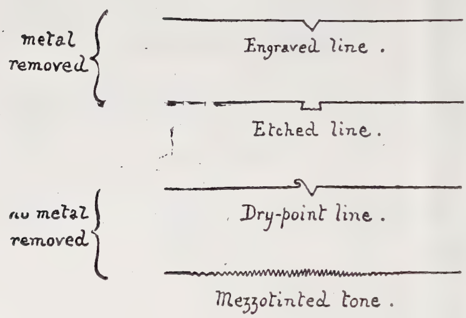


DIAGRAM SHOWING THE MICROSCOPIC FORMS OF LINES CUT ON METAL.

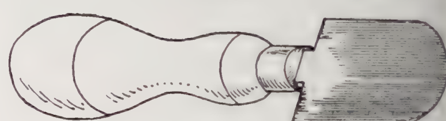
line on metal; in this case the metal is first covered with a thin coating of wax, specially prepared, and upon this a design is marked with a sharp point or needle cutting down to the copper. Then the plate is dipped in a solution of nitric or other acid, which attacks the metal in the places where the wax coating is removed and corrodes it away rapidly. If the plate is left too long in the acid this will undercut beneath

quantity of ink behind its sheltering crest, and produces a thick, soft effect on the paper.

The mezzotinting process removes no metal except by accident, as for instance, when the rocking is carried too far, then the burrs will get so small that they are apt to tumble off and leave only a roughened depression.

The most distinctive tool used in the process of mezzotinting a metal plate is called a

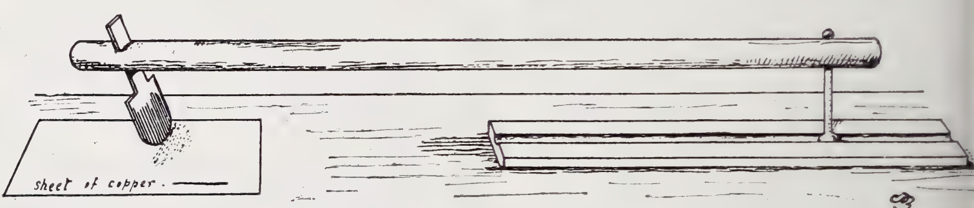
FIG. 2.



ROCKER.

"rocker." It resembles a small spade, and is bevelled at the broad end which has a curved outline (Fig. 2). The flat side of the rocker is channelled finely or coarsely according to the wish of the engraver, and whenever the tin teeth get worn down or perhaps broken in places it is easily remedied by simply sharpening the edge as if it were a chisel, the effect of the channelling being to produce a toothed edge resembling that of a tooth-comb. In the earl times of mezzotinting rockers were made so a to be used in the hand, but of late years a arrangement with a short pole has been substituted, and with this simple appliance it i

FIG. 2a.



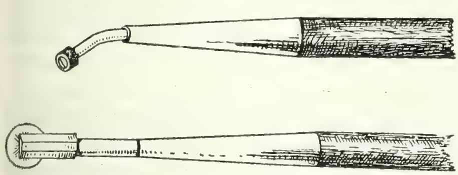
POLE ARRANGEMENT OF ROCKER.

the wax and make broad lines. I mean to say that the acid will, of itself, give other effects than those intended by the etcher, and of course it removes some metal. The next shows a dry point line, no metal being removed, but only a scratch made, throwing up at one side the same amount of metal as is moved by the hard scratching point; the action is similar to that of a plough driving a furrow and throwing up a ridge. On the metal this ridge is called a burr, and it has a very important effect on a print as it catches a

much easier to roughen a plate then it was whe the rocker was handled like a gimlet (Fig 2a The rocker, as now used, is no doubt a d velopment from a roulette. The first mezz tints were roughened by means of roulett held in the hand. They were of many differe forms, ranging from the small toothed whe like the rowel of a spur, with a single line points, to the broad disc, resembling a sma garden roller, which was used by Prince Rupe and his followers. Between these two extrem the varieties of roulettes were many, and it

kely that each mezzotinter designed the form ·hich he preferred for his own use (Fig. 3). ·oulettes were first used to roughen metal lates by L. von Siegen, who found that they ·ere able to produce an effect, rapidly and asily, which, if done point by point in the

FIG. 3.



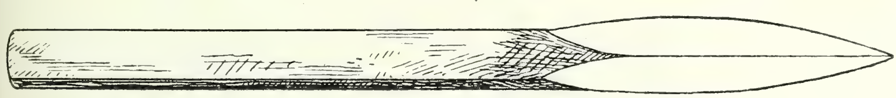
ROULETTES.

:nown "pointillé" manner, would be slow and lifficult.

The most valuable use of a roulette is not in ts use alone, but as an accessory to rocked vork; being quite small it is invaluable to leepen the roughening in particular places, ınd it is also of great use in the event of too nuch scraping having been accidentally done.

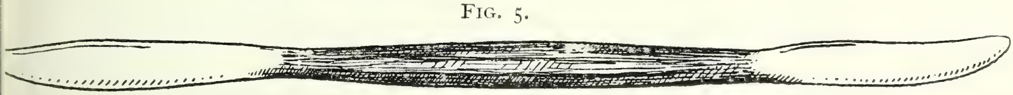
In former days mezzotinters generally laid :heir own grounds, very often only working hem where required, but now the whole of the ›late is evenly covered with the rough grain, ınd this laying of a mezzotint ground is, noreover, done professionally, so that a nodern engraver works on a ground with vhich he is in doubtful sympathy. I think hat the professional laying of a mezzotint ;round militates much against the true art ·alue of the work of any engraver who works ıpon it. It is, however, a slow and tedious ›rocess, the plate having to be crossed some ·ighty times, and in these days of hurry we nust perforce forgive it, as very few mezzo-inters could, or would, spare the time to do it 'or themselves as they ought to.

FIG. 4.



SCRAPER.

FIG. 5.



BURNISHER.

The next important tool used in the production of a mezzotint is a scraper (Fig. 4). Like the rocker, the scraper is of hard steel. It is a short sharp cutting edge set in a handle, and by its use the mezzotinter scrapes away the roughness on his rocked plate as much as he considers necessary. If the scraping is carried far enough all the marks made by rocker or roulette can be erased, and every scrape, when printed, shows more or less as a light place. Scrapers should be very carefully kept dry, as the sharp edge soon loses its value if any rust gets on it, and instead of a clean sharp cut, it makes a jagged scratch. The main difficulty in engraving a mezzotint is in the use of the scraper, so much so that the phrase "scraped" by so-and-so is often heard referring to the engraver. Indeed it may almost be said, especially now that the grounding is usually done professionally, that the art of the mezzotinter consists of his skill with the scraper alone. There is, however, one more instrument that is a dangerously powerful one. Dangerous because it can be made to do easily work of the same kind as can be done with some difficulty with the scraper. This instrument is a burnisher, and the work of flattening down the small roughnesses which are left by the scraper falls to its lot (Fig. 5). A burnisher is a more delicate instrument than even a scraper, because its own function requires a perfectly clear polished surface to work with. If there is the smallest speck of rust on a burnisher it is not safe to use it. Early mezzotinters were by no means so careful about this as they might have been, and the result can be seen in numberless instances where places intended to be pure white show hair marks along their length. Such marks are probably due to small inequalities on the surface of the burnisher.

A hard steel burnisher acting on soft copper

which has been rocked, is capable of polishing out all marks, and consequently of creating a form on the plate which will show white upon a print. Such a small point will be, however, a depression on the copper, and although polished, nevertheless a layer of ink is always likely to remain in it, so it is advisable to go over all such points with a soft wooden point armed with a little whitening, in order to get every atom of the ink out. Such white spots can often be seen on the points of noses, and about the eyes, and for greater effect they are also often helped by the near neighbourhood of burin work—sharp and black.

Practically then, a mezzotinted plate is burred all over, and the art work upon it is done by means of scraper and burnisher, the effect of each of which is towards lightness. The more it is worked upon by these two instruments the lighter the print will be, and in a few places where greater strength of tone may be required, a roulette can be effectively used to restore the requisite darkness. Many fine mezzotints owe much to line engraving, dry point, and etched work, but when any of these are found in any considerable quantity the engraving should properly be called in "mixed manner."

Much importance attaches to the inking of a mezzotint plate, more importance than has been credited to it. A bad inker and printer cannot make a good print from the finest plate, and a good inker and printer can make a decent print from a very bad plate.

Mezzotints were printed in colour at an early period in their history. Joannes Teyler, Professor of Mathematics in the military college at Nimeguen, at the end of the 17th century, printed several of his plates in colour, inking each plate carefully in the proper place with properly coloured ink. Then, a little later, J. Christophe Le Blon began three-colour work. He engraved a separate plate to carry each colour, and used red, yellow, and blue, with sometimes a key-plate in neutral tone. At least one of these plates was mezzotinted, but they are sometimes etched. He described his process in a tract entitled, "Coloritto," published about 1723.

The finest colour work of this kind is now done for the "Société des Amis des Livres," at Paris; the registering of their plates is marvellous, and the effect beautiful. In England, Mr. Cadbury Jones endeavoured some short time back to introduce colour printing for metal plates in the manner of Joannes Teyler, the plates being inked in the different colours, but his endeavours did not meet with the success they deserved.

The early exponents of mezzotint work were all amateurs. The first mention of it is contained in John Evelyn's "Sculptura," published in London in 1662, and he says it was described to him by Prince Rupert. Prince Rupert engraved a small head of "The Executioner," taken from the larger plate, for Evelyn's book, and this is, I believe, the first mezzotint ever published as a book illustration. Evelyn does not describe the process, but it was described by Alexander Browne in a book called "Ars Pictoria," published by him in 1669. In this description no mention is made of a scraper, but the directions advise the use of a burnisher for lightening the plate.

FIG. 6.

"THE GREAT EXECUTIONER," ENGRAVED BY PRINCE RUPERT. 1658.

Prince Rupert was for a long time considered to be the inventor of the mezzotint, but it is now known that Ludwig von Siegen, an officer in the Hessian army, used a system of engraving which ultimately developed into true mezzotint. An excellent account of Von Siegen and his invention can be found in Léon de Laborde's classic "Histoire de la Gravure en Manière Noire," and in this book is a facsimile of a letter which was sent to the Landgrave of Hesse, accompanied with a print of a portrait of his mother the Landgravine Amelia Elizabeth, executed in the new manner. This print, of which I have an excellent slide, is, in my belief, all worked by means of a small single line dotting roulette. Von Siegen's letter is dated 19th August, 1642, and his print is considered to be the first important mezzotint

In places where the roulette has been used closely and strongly a certain velvety effect is found, and this no doubt, being entirely new, gave the idea a start, which was followed up by Prince Rupert and others, and eventually became the chief characteristic of mezzotint work. I take it, however, that in all these early prints the mezzotinting or rouletting has only been done in the places where it was wanted, so that scraping was not necessary, whereas in a true mezzotint the rocking or roughening is systematically done all over the plate and afterwards cut away by means of a scraper as required. In Von Siegen's letter there is no mention of a scraper.

Prince Rupert learnt the new art from Von Siegen, and rapidly improved upon his master's work. Several of his plates are powerful and cleverly managed, the mezzotinting is only put where it is wanted, and there is little or no use of the scraper. The use of the burnisher on metal was well known in Prince Rupert's time, and any corrections he found it necessary to do upon his plates were probably done by means of this instrument. Prince Rupert most likely used a roller with a grooved surface to roughen his plates, and some of them show broad curved impressions from such an instrument. The early mezzotinters were not only amateurs but Dutchmen as well, the Canon von Fürstenburg being a contemporary with Prince Rupert. Wallerant Vaillant, a Dutch portrait painter, assisted Prince Rupert, and himself worked a few plates in the new manner, but neither his work nor that of the Canon was particularly good. Under one of his plates, a portrait of Prince Rupert, occur the words "Prins Robbert, vinder van de Swaarte Prent Konst." The Van Somers and Abraham Blooteling also worked in England; in the case of Blooteling this is particularly fortunate, as his work is in every way excellent, and in consequence of his working here so largely, we count him in the list of English mezzotint engravers. Blooteling was the first to perceive the great artistic possibilities of the new process of engraving, and he taught an assistant, Blois, to prepare his grounds, and these are well and evenly done. Also Blooteling used the scraper, which does not seem to have been used before in the particular way of lightening on all-over darkened plates. The question naturally occurs here as to whether it is possible to say from a print whether a pale place on a mezzotint has been produced by means of a scraper or by a burnisher. I have not time now to go into this question, but will only say that there are certain signs on all such pale places by which it can be said, with some certainty, how they have been produced. Blooteling came here in 1673, and his work quickly became much admired by line engravers, many of whom took up the new process as an amusement; but gradually its powers became more and more appreciated until at last our native engravers became so pre-eminently skilful that mezzotinting was known as an English art.

The early mezzotinters engraved principally after their own drawings, but very soon they became interpreters of the work of other men. At the same time, in a first-rate mezzotint, we must acknowledge a considerable amount of original merit, in addition to the skill of the copyist.

Like the Dutch the first English engravers in mezzotint were amateurs, the two first being William Sherwin and Francis Place. Sherwin counts first because he dated one of his prints, a portrait of Charles II. "1669," and Place dated none of his, though they may have been done earlier than Sherwin's. Isaac Beckett may be considered the first English professional mezzotint engraver. He worked about 1670, and took pupils, among whom was John Smith, afterwards one of our most famous engravers, and a very prolific one.

After Isaac Beckett English engravers in mezzotint increased rapidly in number, and they gradually took the art away from its Dutch votaries; at the same time, the foreigners remained here for some time, and executed much good work. Among these were some well-known artists—Vandervaart, Verkolje, Van Bleek, and Van Haeken.

During the 18th century we do not find the same preponderance of Dutch workmen, but the English names occur almost exclusively. In the beginning of the century John Smith worked most successfully, and was followed by a numerous band of famous engravers, many of whom, owing to the revived appreciation of mezzotints, are now well known.

John Faber, junior, is best known for his engravings after the portraits of the members of the Kit Cat Club painted by Sir Godfrey Kneller. The club was originally political but soon lost that distinction, and the club-room in Jacob Tonson's house at Barn-elms was too low to admit the usual full length figures, so Kneller made his canvasses 36 by 28 inches, and christened this size of picture after the name of the owner of the original meeting-house, Christopher, or Kit Cat.

About 1714 George White inaugurated the introduction of etching into the mezzotint world: he strongly etched his subjects before putting in the mezzotint tones. This principle was afterwards much followed especially in the case of large subject pieces.

A large proportion of eminent 18th century mezzotint engravers came from Ireland, the most eminent of whom was James MacArdell. He largely engraved after Sir Joshua Reynolds, who himself declared his belief that he would be immortalised by MacArdell's work. Then there was his fellow pupil with Brooks, Richard Houston, and Thomas Frye, who engraved large portrait heads after his own drawings about 1740. Other noted Irish engravers were E. Luttrell, Thomas Beard, W. Baillie, John Murphy (who, unfortunately, has only left a few rare plates, all very fine), J. Brooks, Ed. Fisher, Ch. Spooner, J. Dixon, and Richard Purcell.

These engravers and their English contemporaries of the 18th century have left an unequalled series of magnificent portrait engravings after the works, particularly of Sir Joshua Reynolds, P.R.A., J. Hoppner, R.A., Sir T. Lawrence, P.R.A., G. Romney, and T. Gainsborough, R.A., all notable for the beauty of their female types, and in the matter of subject pictures they have engraved chiefly after the works of G. Morland, W. Hogarth, Benjamin West, P.R.A., and J. Zoffany. Among the most notable of the English mezzotinters of the latter half of the 18th century, Valentine Green is one of the best known. He had several pupils of whom John Dean, one of the most delicate of engravers, is perhaps the most eminent. In 1777, Richard Earlom engraved a set of mezzotinted etchings after Claude Lorrain, one of which I have to show you as an experimental slide. J. R. Smith, son of Smith of Derby, was one of our greatest engravers in mezzotint; he made some plates after his own drawings, but is chiefly known for his beautiful interpretation of the works of Sir Joshua Reynolds.

J. Walker, Jonathan Spilsbury (Fig. 7), and C. Turner were all first-rate engravers in mezzotint. C. Turner was a relation of J. M. W. Turner, our greatest landscape painter, and he assisted his eminent kinsman in the engraving of some of the plates of the "Liber Studiorum."

During the early part of the 19th century portraiture still maintained its supremacy, but the application of mezzotint to landscape art is characteristic of a later period. S. W. Reynolds, a pupil of J. R. Smith, was a very successful and skilled engraver. He engraved a series of 357 small mezzotints after the work of Sir Joshua Reynolds. These small plates form an illustrated index of Sir Joshua's work as far as S. W. Reynolds could find it. They are, however, not quite satisfactory, as the process of mezzotinting does not suit very small work any more than it suits very large work. S. W. Reynolds also engraved several plates after his own drawings.

William Say is noteworthy among the earlier 19th century engravers, as he executed a small portrait of Queen Caroline in 1820 which is the first mezzotint engraved upon steel. Underneath the first proof made from this plate is a note:—"This attempt to engrave on steel was made in 1820.—W. Say." The portrait is not

FIG. 7.

"MISS JACOBS," ENGRAVED BY J. SPILSBURY. 1761.

This mezzotint received the premium of fifteen guineas from the Society of Arts, in 1762.

very pleasing, but many mezzotinters have worked in steel since with much success. No doubt the great durability of steel is much in its favour, but there are several technical difficulties connected with its actual use for engraving upon directly, and this has led to the modern evil of mezzotints engraved upon copper being covered with a thin film of steel, so as to give them a lengthened life. From such a steeled plate an infinite number of identical prints can be drawn. From mezzotints engraved upon a copper plate about fifty prints of the finest quality can be drawn, after that the plate begins to deteriorate. The beauty of a print from a copper plate is a rare beauty; that of a print from a steeled plate never can be rare, neither is it equal in quality

o a print made before the steeling operation vas done. There are certain checks upon the ndiscriminate production of prints from steeled plates, but I doubt if they are reliable.

J. M. W. Turner no doubt admired R. Earlom's etched mezzotints of Claude Lorrain's "Liber Veritatis," and it appears likely enough that this gave the former the idea of his "Liber Studiorium," issued in parts between 1807 and 1819. Turner made small sepia sketches, from which he etched the outlines on copper, and then had the light and shade filled in by various engravers in mezzotint or aquatint. Turner himself mezzotinted some of them. Of their kind they are the finest things that have been done, and they have always been favourites with collectors because of the difficulty of getting a complete set of proofs. Turner issued the prints in sets, "Prints" and "Proofs," but, as a fact, they were all mixed, so that to get a real set of proofs together involves a long search and much tribulation.

Quite recently Mr. Frank Short, best known as an etcher, produced a few etched and mezzotinted plates from sketches by Turner, done in the same manner as the old ones, to which they clearly approximate in every way.

T. G. Lupton was the first mezzotinter to work largely upon steel, and he chiefly engraved landscapes. For his success in working this process upon soft steel he received the medal of the Society of Arts in 1822. His work is, I think, the most pleasing of any mezzotinted landscapes, this is partly due to the fact that he used a brown ink by preference. Brown ink is troublesome to manage on steel. I think, altogether, that landscapes are hardly satisfactory in mezzotint, but that the finest effects are to be found among the splendid series of full-length portraits of ladies, after Sir Joshua Reynolds, or one or other of the artists of his period. Three-quarter lengths are perhaps the more usual form in portraiture, both in portraits of men as well as women, but there is a completness about a full-length, which is necessarily wanting in a portrait representing any lesser degree.

David Lucas is particularly known for his interpretations in mezzotint after the landscapes of John Constable, R.A. They are, as a rule, too dark, and are printed in black ink. Sometimes pleasanter prints have been drawn from a worn plate than from a new one, as they are paler. At the same time the original pictures are dark, but I think that if Lucas had used a browner ink, as Lupton did, his landscapes would have been pleasanter. He nearly always engraved on steel. Lucas died in 1881.

Samuel Cousins brings us up to modern times; he gave up work in 1883. His work is always delightful. In 1814 he was apprenticed to S. W. Reynolds, and presently set up for himself at 104, Great Russell-street. He engraved largely both portrait and subject pieces, and his plates are very fully etched before the mezzotinting is put on them. His style may be considered as the modern one, as it has formed the key-note for most of his successors. A large plate, engraved by him, after Landseer, "Bolton Abbey," executed quickly and very effectively in etching and mezzotint, is supposed to have given the death-blow to the old-fashioned, slow, and expensive process of line engraving. It was published in 1837. He engraved largely upon steel.

Mezzotints can now be very efficiently copied by means of photogravure, a form of etching, and probably this process may yet attain greater perfection. At present it leaves something to be desired in the matter of brilliancy—there is too much loss of light. But a photogravured plate can be worked over to almost any desired extent by rocker or roulette, burnisher and scraper, so that it can be made almost identical with the original. A photogravure made direct from a painting is often very good, but here, again, it generally needs a little skilled handwork in weak places.

What with steel-plating of copper-plates, and the direct competition of photographic processes, it is probable that mezzotinting as a high art has had its day. Except for the work of a very few living engravers of the first rank in this method, mezzotinting has already reached its highest development, and we may well be proud of the beautiful examples which have been left to us by MacArdell, Valentine Green, J. R. Smith, and others of their period, men whose talent has been great enough to earn for their particular art of engraving the title of "La Manière Anglaise."

List of Lantern Slides Illustrating the Paper.

1. Diagram showing analysis of the lines made on metal in the processes of intaglio engraving.
2. Diagram of the tools used in mezzotint engraving.
3. Specimen of rouletted engraving inked in coloured inks.
4. "Amelia Elizabeth, Landgravine of Hesse." Engraved by L. von Siegen. 1642.

5. "The Great Executioner." Engraved by Prince Rupert. 1658.
6. "The Standard Bearer." Engraved by Prince Rupert. 1658.
7. "Louise, Duchess of Portsmouth." Engraved by A. Blooteling. c. 1674.
8. "James, Duke of Monmouth." Engraved by A. Blooteling. c. 1674.
9. "The Coke Family." Engraved by Paul van Somer. c. 1680.
10. "Charles II." Engraved by R. Williams. c. 1680.
11. "Philip Woolrich." Engraved by F. Place. c. 1680.
12. "Jupiter, Juno, and Io." Engraved by J. Smith. c. 1690.
13. "Night." Engraved by R. Houston. c. 1690.
14. "Lady Middleton." Engraved by J. MacArdell. c. 1750.
15. "The Lords John and Bernard Stuart." Engraved by J. MacArdell. c. 1750.
16. "Mrs. Bonfoy." Engraved by J. MacArdell. 1755.
17. "The Duchess of Ancaster." Engraved by J. MacArdell. 1757.
18. "Miss Jacobs." Engraved by J. Spilsbury. 1762.
19. "Queen Charlotte." Engraved by T. Frye. 1762.
20. "Mrs. Abingdon." Engraved by J. Watson. 1769.
21. "Mrs. Bouverie and her Son." Engraved by J. Watson. 1770.
22. "Kitty Fisher." Engraved by E. Fisher. c. 1770.
23. "Mrs. Abingdon." Engraved by Eliz. Judkins. 1772.
24. "Boy with Lamb." Engraved by J. Dean. 1776.
25. "Lady Kent." Engraved by J. Dean. 1779.
26. "Warren Hastings." Engraved by T. Watson. 1777.
27. "The Countess of Warwick." Engraved by J. R. Smith. 1777.
28. "Mrs. Carnac." Engraved by J. R. Smith 1778.
29. "Lady Catherine Pelham-Clinton." Engraved by J. R. Smith. 1782.
30. "A Bacchante." Engraved by J. R. Smith. 1784.
31. "Nature." Engraved by J. R. Smith. 1784.
32. "Serena." Engraved by J. R. Smith. c. 1784.
33. "Mrs. Sheridan." Engraved by Gainsborough Dupont. c. 1780.
34. "The Duke of Bedford." Engraved by Valentine Green. 1778.
35. "The Countess of Salisbury." Engraved by Valentine Green. 1781.
36. "The Duchess of Devonshire." Engraved by Valentine Green. 1780.
37. Etching and mezzotinting on a print belonging to the *Liber Veritatis*. Engraved by R. Earlom. c. 1780.
38. "Flowers and Fruit." Engraved by R. Earlom. 1781.
39. "Col. Mordaunt's Cock Match." Engraved by R. Earlom. 1788.
40. "The Right Hon. W. Pitt." Engraved by R. Earlom. 1806.
41. "Mrs. Davenport." (In colour.) Engraved by J. Jones. 1784.
42. "The Countess Spencer." Engraved by C. Hodges. 1785.
43. "Mrs. Curtis." Engraved by H. Hudson. 1789.
44. "The Duchess of Bedford." Engraved by S. W. Reynolds. c. 1790.
45. "The Cottagers." Engraved by W. Ward. c. 1792.
46. "The Misses Frankland." Engraved by W. Ward. 1797.
47. "Inverary Pier." Engraved by J. M. W. Turner. 1811.
48. "The Shipwreck." Engraved by C. Turner. 1807.
49. "Lord Castlereagh." Engraved by C. Turner. 1830.
50. "Mrs. Wolff." Engraved by S. Cousins. 1831.
51. "Queen Victoria." Engraved by S. Cousins. 1839.

DISCUSSION.

The CHAIRMAN hoped that those among the audience who were not familiar with the subject, would take the opportunity of seeing the actual tools with which mezzotinting was done. It was one of the most difficult things in the world to explain directly a technical matter of that kind in words, although Mr. Davenport's diagrams and sections of lines actually made by the instruments, and the diagrams of the instruments themselves would assist in explaining it. He believed it was actually known now, from a very rare old plate, that there was a special roller, and that the artist Mr. Davenport had mentioned, did actually use, not a rocker in the modern sense of the kind which had been thrown on the screen, but that he prepared and roughened his ground by an instrument such as Mr. Davenport suggested, a kind of roughened barrel or roller. There was an actual illustration of that instrument as used by him. Mr. Whitman had shown him the picture a few days ago, and perhaps he would give some further information.

Mr. A. WHITMAN said it was in a little book which had been brought to his notice, that had been published in 1688, 28 years after mezzotint engraving was brought into this country. In that book there was

a printed description of the way in which mezzotinting was done, and the description was accompanied by an illustration, which showed in diagrammatic form the tools which were actually employed. The tool with which the ground was laid was an actual wheel, measuring about an inch in diameter and about a third of an inch in width. It was made in some hard metal, and was hatched; and the roller was then allowed to roll over the plate and roughen it, and thus form the ground. In regard to the illustration which had been thrown on the screen of "The Great Executioner," a point that had excited a great deal of attention and comment was as to how the ground was laid. From the illustration to which the Chairman had referred, he thought it was now pretty clear as to the way in which the work was actually performed. He ventured to think that from that roller one might now be quite sure the ground was not made in the way Mr. Davenport had indicated. The illustration on the screen made it appear as though the lines had been drawn by a roulette sweeping right across the plate, and that was what was generally understood to be the case. By the help of the illustration referred to, however, it could be shown to be entirely different. He had argued the question quite recently with an engraver, who was at first very much opposed to his view, but eventually came round to the opinion that the way he (Mr. Whitman) put it was really correct, viz., that the roller was employed, using the elbow as the centre of a circle, and the roller being wriggled up and down across the plate. The picture would explain what he meant. [The illustration of "The Great Executioner" was then thrown on the screen.] One might take the left hand bottom corner as the spot where the elbow would be placed, and one would see the curves that passed right across the plate from this centre, which gave the impression that the curves were made in that sweeping direction. By the help of the illustration in the 1688 book, however, which had been in the possession of Sir Seymour Haden till quite recently, he thought it would be manifest that the grounding was done by the roller, which was therein illustrated. That, he believed, was a new way of looking at the early mezzotint ground. There had been a great deal of discussion upon the subject, but he thought the real solution of the question would be found in the direction he had indicated. The title of the book was "The Excellency of the Pen and Pencil." The publisher's name was Dorman Newman, and the date of it was 1688. There was a copy in the British Museum, and at first he had been very sorry to find that the particular illustration was missing from it, but as since then Sir Seymour Haden had given him his, he was rather glad that the British Museum copy was incomplete while his own was perfect.

Mr. C. W. SHERBORN said he had been very much interested with the lantern slides on the screen. At the same time, the illustrations did not give quite the right idea of a fine proof. It was very evident from the old proof referred to that a roller was used, which went straight across the plate. The South Kensington Museum had a very fine proof of "The Executioner," and he hoped those present would pay the Exhibition a visit. There were also many other fine specimens of mezzotints. It would add to one's knowledge of mezzotints immensely, to go there and study them carefully, especially after the very excellent account of the process they had just heard. His own work was done with the graver, although he had done one or two little plates in mezzotint, and knew something of the *modus operandi*.

The CHAIRMAN said with regard to Mr. Sherborne's remarks they must all acknowledge that the method of showing illustrations of that class of lantern slides had the great advantage of being visible to the whole audience, and of being striking by light, but it had its disadvantages obviously in the coarsening character of the work, the scale, and the grain. No doubt the audience had been able to make due allowance for that exaggerated coarseness. Mr. Sherborn had spoken of the opportunity for the study of mezzotints now afforded at the South Kensington Museum by the Exhibition of English engraving in general, suggested by the Society of Arts. He would also recommend those of the audience who wished to follow up the subject further to come next year to the exhibition in his department in the Museum, where they would see a selection of 600 or 700 mezzotints not to be equalled or paralleled, the very finest proofs of the art from the beginning down to what seemed to him its entire decay in 1820, when steel superseded copper. That exhibition would consist of very picked specimens from that magnificent bequest which had lately come to them from Lord Cheylesmore, supplemented in places where it happened to be deficient with the best of their own store. Therefore, from the invention of Ludwig von Siegen down to the works of Samuel William Reynolds, Turner, and Say, before the introduction in 1820 of the steel plate, they would exhibit the very best that could be seen, in proper chronological order, and, he hoped, with proper explanations, so that no opportunities would be wanting for the study of the subject which Mr. Davenport had introduced in so very interesting and so vivid a way in his paper. He proposed a hearty vote of thanks to the author for the pains he had taken.

The vote was carried unanimously.

Mr. DAVENPORT, in returning thanks, said he would look up the book mentioned by Mr. Whitman. In the meantime he would endorse the Chairman's invitation. When the mezzotints were exhibited the public would certainly see a collection quite unequalled anywhere else.

Miscellaneous.

NEW TURBINE STEAMER, "THE QUEEN."*

This new turbine steamer, built at Messrs. Denny's works at Dumbarton for the South Eastern and Chatham Railway, marks a departure in cross Channel steamers. Hitherto these vessels have been of the paddle or ordinary twin screw type, but the new vessel is a turbine steamer, and is an enlarged example of the vessels which have been so successful for river purposes on the Clyde. The new vessel is 310 feet long with a moulded breadth of 40 feet and a depth of 25 feet, and has a complete awning deck. In large deckhouses on this deck there are a number of special cabins provided for the convenience of passengers. Amidships is the smoking-room. Above this first-class accommodation there is a promenade deck extending out to ship's side, which shelters the awning deck in wet or rough weather, and provides a large promenade for passengers in fine weather. The ladies' accommodation is in a large apartment on the main deck. Immediately below this is the gentlemen's sleeping saloon. Abaft this is the resturant. Twelve state rooms and two special royal state rooms are provided for on the upper deck. The second-class accommodation is situated aft, the ladies' cabin being in large deckhouse on awning deck, the roof of which extends out to ship's side, forming a sheltered promenade in wet weather. The gentlemen's accommodation is on the lower deck and consists of comfortably upholstered sofa beds for the night service. A large open space is also provided on the main deck as a shelter during the day service. The crew are accommodated on the lower deck right aft, and the officers and engineers on the main deck amidships.

The machinery consists of Parsons turbines, three being fitted, having three lines of shafting. In manœuvring the centre shaft runs free, the two side shafts then take the place of ordinary twin screws, and has been demonstrated in the *Queen Alexandra*, running daily upon the River Clyde, the manœuvring power is in every respect as good as in ordinary twin screws, while in the going astern there is none of that objectionable vibration which is to be felt in the most modern twin-screw balanced arrangement. Turbines can now-a-days be worked from zero to maximum pressure. The side screws tend to obviate rolling in the vessel, and there is ample draught to prevent vessel pitching, without excessive the draught, as a captain and his engineer on board can generally realise the friction produced by every inch of vessel submerged.

The usual triple expansion engines are, in the case of the *Queen*, replaced by turbine machinery on the latest improved plan as designed by Mr. Parsons, whose genius has completely revolutioned the problem of high speed marine steam engines. The main engines in the *Queen* consists of three separate turbines, each driving its own line of shafting, the centre turbine being high pressure and the two side ones being low pressure. When going ahead in ordinary work the steam is admitted to the high pressure turbine, and after expansion there, passes to the low pressure turbines and then to the condensers, the total ratio of expansion being about 125 fold, as compared with 8 to 16 fold in triple expansion reciprocating engines. At the ordinary steaming speed of the *Queen*, the revolutions of the centre shaft are about 700, and of the two side shafts about 500 per minute. This high rotative velocity implies the adoption of propellers of small diameter, and the utmost care is exercised in balancing them so as to obtain the full advantage of the absence of vibration obtained by the adoption of the turbine principle.

When going full speed ahead, all the lines of shafting, central as well as side, are in action, but when coming alongside a quay, or manœuvring in or out of harbour the outer shafts only are used, thus giving the vessel all the turning and manœuvring efficiency of a twin screw steamer. The means for obtaining this manœuvring power demands a word or two of explanation. Inside the exhaust end of each low pressure turbine cylinder is placed an astern turbine, controlled by slide valves operated by combined steam and hydraulic reversing engines. These valves admit steam directly into the low pressure turbines, or into the reversing turbines, within same, for going ahead or astern. The centre turbine, under these circumstances, revolves idly in a vacuum, its steam admission valve being closed, and its connection with the low pressure turbines being closed by non-return valves. The centrifugal circulating pumps, and the air pumps, all of which are in duplicate, one set for each of the two condensers, are driven by independent double cylinder steam engines, and the feed water is supplied to the boilers by two of Weir's feed pumps controlled by a float tank into which the air pumps discharge the condensed water. There are also special pumps for wash deck and fire service, as also the various pumps for oil and water circulation as required by Parsons' system. Steam is supplied to the turbines by two double and two single ended boilers, Scotch cylindrical type, constructed by Messrs. Denny and Company, the working pressure being 150 lbs. One noteworthy feature on board the *Queen* will be the absence of the hot cinders and dust, which are, and more especially to ladies, such a nuisance on board most steamers fitted with forced draught. The funnels of the latest Dover and Calais steamers are fitted with the Denny and Brace spark arrester, by the use of which the decks can be kept as clean as those of a yacht. To conclude, the adoption of the Parsons' turbine principle of propulsion for high speed vessels, not only gives a

* From a paper read at the South-Eastern Union of Scientific Societies' Congress held at Dover, June 12th, by Mr. A. T. Walmisley, M.Inst.C.E., Engineer to the Dover Harbour Board.

substantial increase of speed, but also by its freedom from reciprocating parts completely obviates those troubles, caused by vibration, which have been so annoying to those whose fortune it has been to travel on board of the flying vessels demanded by the modern voyager.

Mr. Walmisley expressed the opinion that the new passenger steamship would answer all the anticipations of her builders, and the desires of her owners, and continue running until the next improvement. What that would be we cannot tell, but it is very possible that in the future, electrical action would be the motive power.

*CAUSE OF DEPRESSION OF TRADE IN CHINA.**

There is at present a depressed feeling in all things, political and commercial, in China, no one knowing what is going to happen next. I hope to make the cause of this depression plain in this paper, and will venture an opinion on the future from present facts.

The returns of trade and reports for the years 1899 and 1902 give very concise data of our commercial position in China before and after the Boxer troubles of 1900. It must be noticed by all who are interested in the welfare of China that trade which showed such astonishing development in 1899 and received such a shock in 1900, has not yet recovered in many districts as was hoped and expected.

Our percentage of trade is decreasing; with Germany and Japan, in particular, it is increasing. The number of British ships has decreased owing to their being larger, but the tonnage has increased. Total value of our trade has increased, but not in proportion to other nations. The trade done by China themselves through the Imperial Maritime Customs is decreasing, which shows a want of confidence in the existing *régime*.

Mr. F. E. Taylor, Statistical Secretary to the Imperial Maritime Customs, mentions in his report of 1902, that conditions were not altogether favourable to commerce, and mentions the fact of a rebellion in the south, and want of confidence in the northern provinces, as retarding influences; there is also rebellion in the north-western provinces, that he does not mention. It is on these and other retarding influences I write (rather than comment on the reports, excepting in so far as to bear out other facts and my opinion).

Mr. Taylor also says it is disappointing to note that trade seems to be the first victim when heavier taxation is decided upon. I will put the carrier or ship in the same category, and mention a few retarding influences where they also suffer quite unnecessarily. The new Yangtse regulations that came in force April 1st, 1899, may have helped things somewhat by opening up the inland waterways, but neither these regulations, or any others made since, have touched or abolished the antiquated system of river pass, which is delay, vexation, and annoyance to every ship entering the Yangtse; time which is money to the shipowner is lost here, and nothing whatever gained by the Customs.

When the Imperial Customs post-offices started a few years ago, naturally they had to arrange for the carrying of mails, so it was arranged that half the night or overtime fees paid by shipping should be remitted, and all steamers on the coast and rivers of China should carry the mails. What next! Why the Customs doubled the fees; by so doing they got the mails carried for nothing, the ships being responsible and paying the cost in extra fees.

Passengers formerly could land at any time from steamers plying on the Yangtse, now a fee is charged if passengers land from a steamer during the night, and before 6 a.m. How does it come about that these fees are clapped on at will by the Customs authorities.

It will be noticed that the tonnage dues collected in 1899 was 355,756 taels; in 1902, it was 434,034 taels, and increasing. British ships paid 56 per cent. of the total in 1899, and 47 per cent. in 1902. With the great amount of tonnage dues collected, and a treaty made at the close of the 1900 troubles, yet nothing, beyond electing the foreign members of the Conservancy Board for the Shanghai River, has been done. Doubtless the usual Chinese official obstruction is the cause, and the entrance to the Whangpo River at Woosung is getting worse daily.

The Customs returns for Chungking, Ichang, Kiukiang, and Wuchow, is much less than in 1899. It recovered somewhat in 1901, to fall again in 1902, excepting at Kiukiang, which shows a steady decline. At Hankow and Newchwang trade is very slow to recover; in no case do the figures touch those of 1899.

With the opening of the northern trade in the spring of 1902 trade started off briskly, but a reaction soon set in, and by Midsummer but little was doing in many districts. With regards Newchuang, it is doubtless brought about partly by the abnormal condition of things generally in north China, which is more or less dominated by Russia. Some people blame the fall in value of silver, and perhaps that great fact has a little to do with it; for the real cause we must look elsewhere, at the cloud that is just above the horizon, where it has been since 1898. The Powers are partly to blame for this reaction; chiefly ourselves by our inaction in 1898. Had we then supported the Emperor and the reform party, the troubles of 1900 would have had no place in the world's history. In 1900, when we had this country at our feet, vengeance was vowed against the evil doers, and death was the sentence passed by the powers on the leaders of the diabolical plot. Yet what occurred? Some are still in power and constitute the

* Communicated by Mr. G. Mobsby, Shanghai.

existing Government, others were banished (in name only), to assume a power that the existing Government is powerless to overcome. Prince Tuan and General Tung-fu-hsian (the latter opposed the allied army in its march to Peking in 1900) were to have been executed, as they richly deserved. A reprieve was granted by the Powers, the sentence being altered to one of banishment. Exiles with an army of 10,000 or 15,000 men, recruited largely from the disbanded Imperial troops, and encamped, in December last, in a stronghold thirty miles north of Ku-yuan city, on the borders of Kansuh and Shansi, the whole district being dominated more or less by them.

The Boxers overran the province of Szechuen; this accounts for the loss in native opium revenue last year of 646,566 taels, it being the principal opium-producing province. During last year trade was almost annihilated in some districts.

The rebellion in Kwansi is gaining ground; this is confirmed daily from many sources; yet the Court officials deny the whole thing, and lie, as they always have done.

The above facts are the cause of decreasing revenue in districts bordering on provinces where actual rebellion is in existence.

There are now, while I write, missionary troubles 60 miles east of Ichang, near Tan-Yang, and disquieting reports from Shangtung Province, where open conflicts are occurring frequently, and at Peking and the North generally business is almost paralysed.

How is it possible for trade to develop under the above circumstances, and what is the use of making commercial treaties with a Government who have practically lost control of half the country and its people.

What is to be the outcome of it all? No answer can be given; an opinion is all one can venture on.

We are on the eve of a great struggle between reformer and Manchu. Here it must be noted, the rebellion in Kwangsi and that of Prince Tuan are not identical, that of the latter is political, and decidedly against the foreigners, that of the former is for reform, and against the Manchu; and not so much against the foreigner we are given to understand, so it behoves us to watch passing and coming events very closely.

We have lost the strong, and probably the best friend we had in China, in the death of Viceroy Lui-Kungyi. Viceroy Chang chi-tung being now without a coadjutor, may be unable to aid us as in the past. The present Viceroy of Nanking, Wei-hu-Chong, is little known to foreigners. He is a Hunanese, and late Governor of Yunan. His appoint- is looked upon by the Reform party as a check against progress; however, this remains to be seen. Yuen-shih-ki, Viceroy of Chihle, can hardly be trusted. He aided the Empress-Dowager against the Emperor in 1898, and when the Boxer troubles started in 1900, he watched events awhile, before casting in his lot with foreigners, doubtless knowing his best interests were with the winning side; however, he has done well for us after he made up his mind, and helped the missionaries a lot in 1900. He probably owes his present high position for service rendered in 1898.

The outlook for increased trade is not now so brilliant as immediately after the troubles of 1900. The reforms then promised are all dead, consequently there can be no hope for any great and lasting improvement until the country becomes settled under a Government pledged to reform and the uprooting of existing evils; nothing less than this will satisfy the reform party, who at present are lying dormant and scattered, with evident signs of activity as opportunity offers.

The present attitude of the Government is suicidal and almost beyond the endurance of the people. Unless some great change takes place quickly, a great conflict that will shake the empire to its foundations must ensue. In the meantime we can only wait for the mighty power of reform to come along and throw open the doors of this gigantic storehouse of untold wealth.

PAPAIN INDUSTRY AT MONTSERRAT.

It may not be generally known that a small and remunerative industry in dried papaw juice has existed at Monserrat for several years. Regarding this the agricultural instructor, Mr. Jordan, has recently contributed the following interesting notes:—

"The trees are usually self-sown, growing among rocks on the mountain sides, or else are planted around the houses of the peasantry. The peasants collect the juice in calabashes into which a small quantity of water is first placed. The juice is obtained by lightly scoring the rind of the fruit with a knife or some other sharp instrument. As the juice falls into the water it thickens to the consistency of ice-cream and in this state is sold to the manufacturer at the rate of ¾d. to 1d. an ounce."

"There is at present a small plot of 120 trees under observation at the Grove Experiment Station, of these about 25 per cent. are males or non-fruiting trees. The plot was planted in May, 1902, and has yielded to the end of December last, a period of about seven months, over 10 pounds of juice. There are two varieties under cultivation, the long and the round fruited. With regard to the respective merits of these, our experience is that the long-fruited variety bears earlier and nearer the ground, both strong points in its favour. It is, however, claimed that the round variety gives the largest quantity of juice. This may be true, but as the latter grows to a considerable height the cost of collecting the juice in greatly increased in the case of old trees.

"I may add that one of the student-gardeners at the station, where trees are plentiful, can collect on an average 4 oz. of juice per hour. The price of dried papain at the present time varies from 12s. to 16s. per lb."—*The Agricultural News* (Barbados).

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FRIDAY, JULY 10, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CHAIRMANSHIP OF COUNCIL.

On Monday, 6th inst., at their first meeting, the Council elected Sir William Abney, K.C.B., D.C.L., F.R.S., as Chairman for the ensuing year.

The various Committees were also re-appointed.

EXAMINATIONS.

The results of this year's Examinations (Grade II.) will be published to-morrow (Saturday). The Grade I. results will be issued about the end of the month.

The dates for the Examinations in 1904 (Grade I. Elementary, and Grade II. General) will be March 21, 22, 23, and 24. The last day for receiving entries will be February 24.

The special subject for Commercial Geography (Grade II.) in 1904 will be "British India, Ceylon, and the Straits Settlements."

REPORT OF THE ZEBRA DOMESTICATION EXPERIMENTS.

[The Society of Arts have been favoured with permission to publish the following Report to the Secretary of State for Foreign Affairs on the Zebra Domestication Experiments in the East African Protectorate, by Robert J. Stordy, Veterinary-Officer to the Uganda and East African Protectorate, with the accompanying illustrations.]

Although the estimates for the financial year, 1902-3, contained a grant by Government for experiments in zebra-domestication, it was not till the middle of July that my veterinary duties allowed me to proceed to the Morendat River, where a suitable site had been selected on which to build the stockade or boma for the capture of the animals. (Fig. 1, p. 692.)

The reasons which induced me to fix upon the site were, *i.e.* :—

1. The presence of large herds of zebra.
2. A never failing water supply.
3. Porous sandy soil.
4. Very fair grazing.
5. Large amount of timber available for the construction of the boma.
6. Natural formation on both sides of a shallow ford which seemed to facilitate the prospective driving operations.
7. The absence of other game in inconvenient numbers.

The Boma.

The construction of the boma employed fifty hands for the space of nine weeks. (Fig. 2.)

Light trees from four to six inches in diameter, and numbering five thousand six hundred, were cut on the adjacent escarpment, and brought down to the ford, a distance of nearly two miles. Nine hundred corrugated iron sheets had been supplied, but these proved quite insufficient for the whole circumference of the stockade. The manner in which the corrugated iron sheets were used, was to nail them to jungle-wood posts spaced about three feet apart and let three feet into the ground, and supported from behind by sloping struts.

This can be readily seen in several of the accompanying photographs, notably Fig. 3; where also can be seen the large mass of cut branches which were introduced to mask the iron sheeting.

After the supply of iron sheets was exhausted, the remainder of the boma was composed of twelve foot jungle woods posts set eight inches apart, and, as before, let into the ground and solidly supported from behind. (Fig. 4.) The total length of the fencing exceeds a mile, and the enclosed area is over forty-eight acres.

It will be noticed in the plan (Fig. 1) that the river front has no fencing; it was unnecessary to continue the stockade, as the river banks are thirty to forty feet in height at this point.

The Arm.

On the side of the river remote from the boma it was considered necessary to build an arm of cut trees, to facilitate the driving of the zebra in the direction of the ford. It was hoped that upon the zebra entering the arm a capture would be effected, as they would be

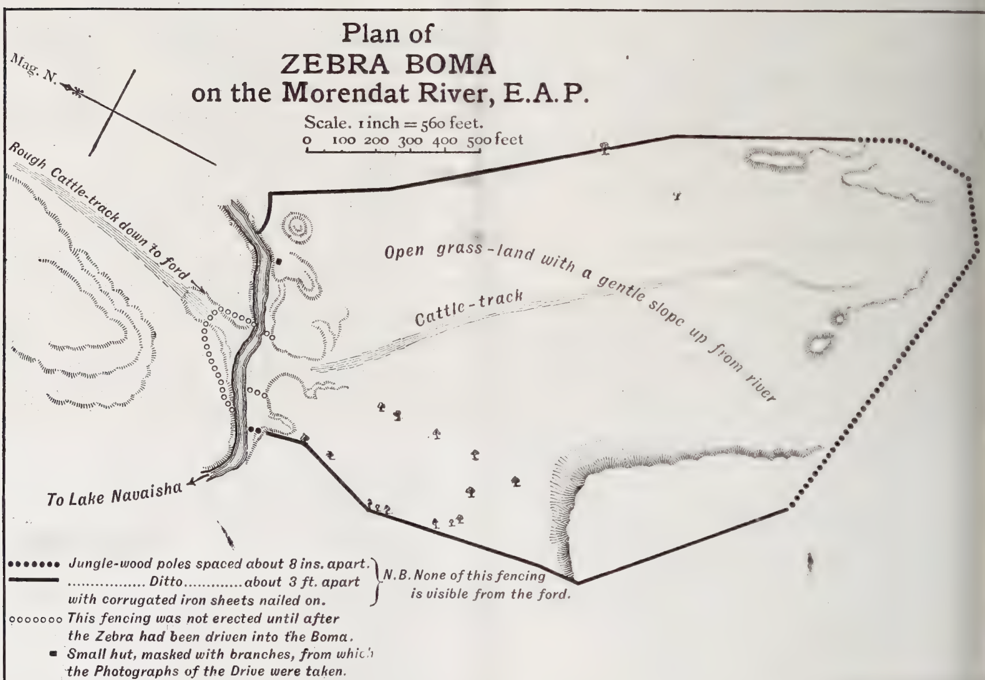
hemmed in between the arm on the one side and a steep hill backed by the river with precipitous banks on the other side, while the beaters behind would form a cordon from the hill to the arm. Thus the only available direction for the zebra to travel would be towards the ford and the boma. A couple of masts 50 feet high were erected, one on the arm and the other on the hill. The beaters were informed that it was between these two points that the animals must be driven.

As there were, in the vicinity of the boma, a

exactly as arranged. A complete cordon of beaters surrounded the ground where the zebra had so often been found grazing. As the line of beaters approached the open plain near the river it was seen that the cordon enclosed no less than four herds of zebra, a total of nearly three hundred head. As the cordon closed in the animals became panic stricken, and one after another the four herds charged through the line of beaters with an impetuosity that nothing could resist.

Our first attempt at capturing wild animals

FIG. 1.



Walker & Cockerell sc.

number of fords in use by the Masai for watering purposes, it was necessary that all should be closed with the exception of the one leading into the boma. This was effected in one case by building a dry stone wall across the approach (Fig. 6), and the other five by building stockades of the same type as employed in the boma.

THE FIRST DRIVE. (October 8th, 1902.)

Arrangements were made for our first zebra drive to take place on the morning of the 8th October. A body of seven hundred Masai was gathered at the Gilgil River, by the collector, Mr. Macallister, on the evening of the 7th. At sunrise next morning the drive was carried out

which had opened so hopefully at daybrea thus came to a disappointing close befo 8 a.m.

THE SECOND DRIVE. (February 21st, 190

The arm, composed of cut trees on the nor side of the river, was increased in length fro a quarter of a mile to nearly two mil Frequent minor floods of the river deferred t next drive till last month. As the river w then very low, arrangements were made fo drive on a larger scale than before. It w hoped that fifteen hundred Masai could be su- plied from the Nairobi district in addition the few hundreds to be obtained locally. was expected that with this large increase

Fig. 2.

Fig. 3.

FIG. 4.

FIG. 5.

FIG. 6.

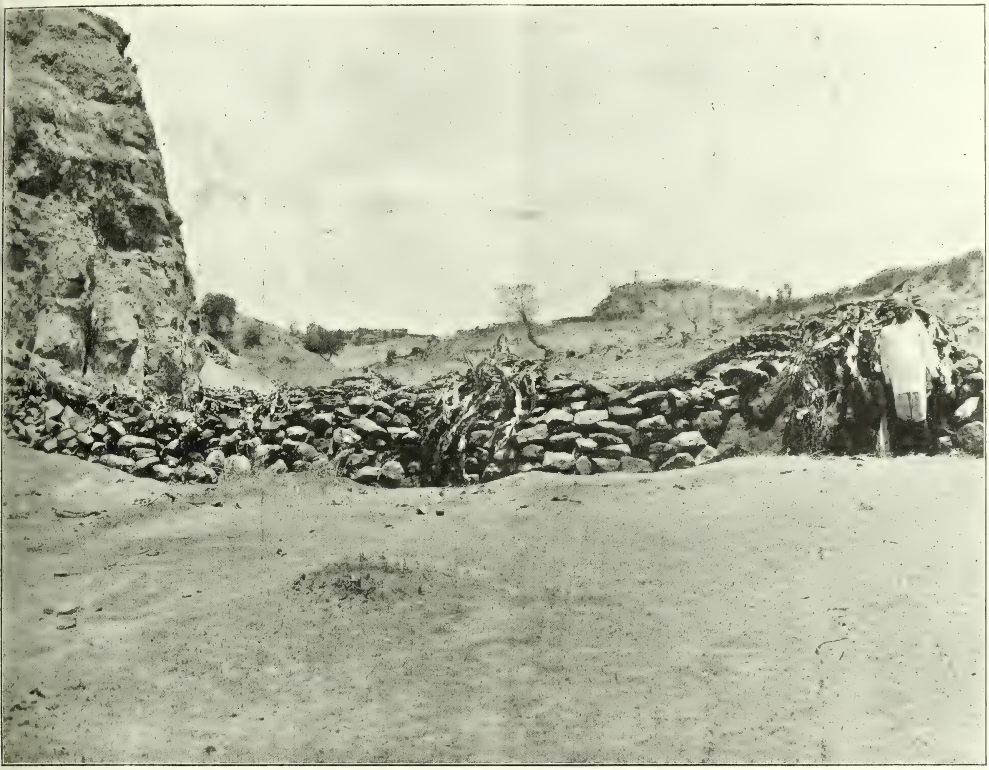


FIG. 7.

FIG. 8.

FIG .9.

FIG. 10.

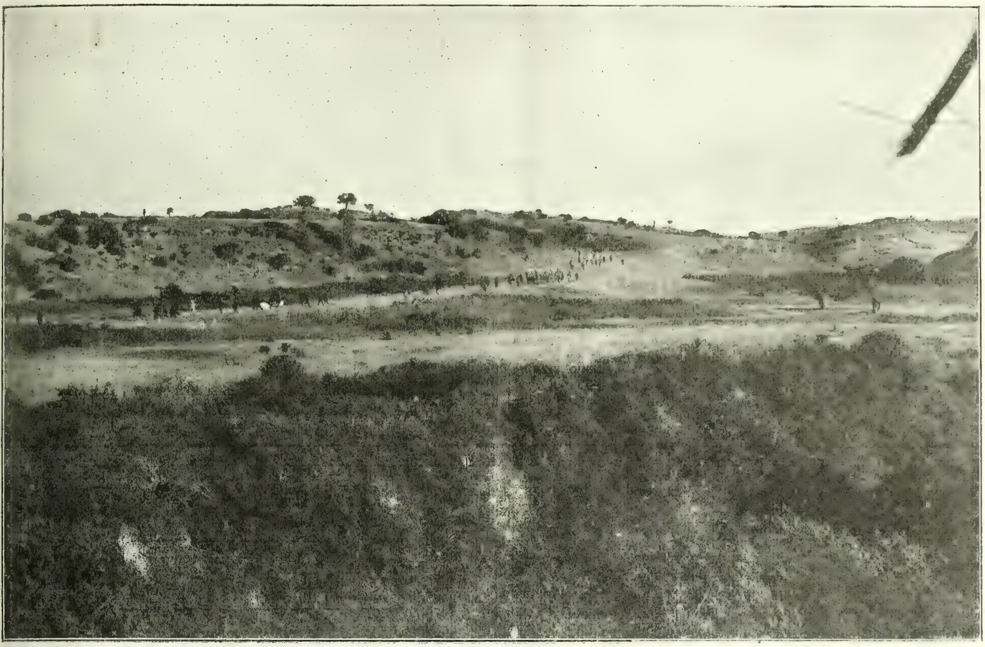


FIG. 11.

FIG. 12.

THE BEATERS WHO DROVE THE ZEBRA.

FIG. 13.

ZEBRA IN THE BOMA.

the number of beaters, the zebra would not attempt to break through, as they did on the first occasion. It was with considerable disappointment that I heard the night before the drive that no Masai could be sent from Nairobi. However, as all arrangements had been made, it was resolved to make an attempt next morning with the four to five hundred Masai who had been collected by Mr. Wise.

As before, the beaters were collected at the Gilgil River on the evening previous to the drive. Much was expected from the six mounted Europeans, *i.e.*, Messrs. Allen, Bagge, Collyer, Routledge, Story, and myself, whose aim was to keep the zebra on the run, and allow them no time to concert offensive tactics. Messrs. Archer and Salmon, on foot, took charge of the Masai beaters. A start was made at daybreak, and the line of beaters immediately put up about 100 zebra, and drove across the plain towards the arm. As they approached it, the herd, which, as usual, was led by an old stallion, broke away in the direction of the railway line, and actually got outside the cordon. A piece of fine riding by Mr. Allen, ably seconded by Messrs. Bagge and Routledge, resulted in the herd being headed back again into the line of beaters. At the far side of the plain I had managed to drive a small herd of twelve or fourteen head into the arm, and it was my endeavour to keep the herd within the arm until the line of beaters had closed up the entrance. Our satisfaction may be imagined when the large herd, which had been headed back, got the wind of the small herd, and themselves entered the arm at full gallop, closely pursued by the horsemen and Masai. As they approached the river they became suspicious, and returning at the gallop, made a final attempt to rush the beaters, but they were driven back with a liberal expenditure of blank ammunition on the part of the Masai irregulars from Naivasha Station. Turning round, they made straight for the ford, crossing it without hesitation. (See photographs Fig. 7, stallion leading the herd down to the ford; Figs. 8, 9, zebra crossing ford; and Fig. 10, beaters following behind.)

The ford was then closed in with posts, the holes for which had been previously dug and filled up with grass. (See photograph Fig. 11; the young tame zebra which was tied up at the entrance to the arm as a decoy is seen in the foreground.)

Elaborate precautions were taken that night to ensure that the zebra would not get out, as the closing of the ford had not been completed as thoroughly as was considered necessary. Subsequent counts showed the number of animals to be eighty-five, two foals have since been born in the boma, and the old and young are becoming wonderfully tame. They now frequently graze within a few feet of the tents in which my men are encamped, which have been pitched within the boma. I have considerable confidence that shortly we shall be able to start the handling and breaking of the young animals.

In conclusion, I wish to express my best thanks to Mr. Bagge, Sub-Commissioner Naivasha Province, who has at all times given me the readiest assistance; to Mr. Wise, collector, who arranged for the presence of the Masai beaters; to Mr. Ross, assistant engineer, Uganda Railway, who kindly took the photographs of the drive, and who supplied the plan of the boma which is sent herewith; to Messrs. Archer and Salmon for the able way in which they handled the Masai; and to the mounted men whose names I have mentioned, to whom the success of the drive is really attributable.

ROBT. J. STORDY,
Veterinary Officer.

April, 1903.

Miscellaneous.

ATMOSPHERE OF THE CENTRAL LONDON RAILWAY.

The London County Council have published the reports of the chemist and the medical officer on an examination of the atmosphere of the Central London Railway in 1902, with the report of Dr. Andrewes on the micro-organisms in the air.

Dr. Frank Clowes reports that a consideration of the results obtained from the examination of the samples of air collected on the Central London Railway shows that, generally, the quantity of carbon dioxide was highest in the air of the carriages; but that, contrary to what might reasonably have been expected, the largest quantity was not found in the carriages where smoking was allowed. The highest proportion of carbon dioxide (14·7 volumes in 10,000 of air) was present in the air of an ordinary passenger carriage on October 10th. The smallest quantity found was that present in an empty carriage on October 16th, viz., 9·6 volumes in 10,000 volumes of air.

The air in the passages leading to and from the stations was generally better than that in the lifts On one occasion (June 6th) the air in the lift at the Oxford-circus station contained 15·2 volumes of carbon dioxide in 10,000 volumes of air, or about four

times the quantity found in the fresh air outside the station.

On May 16th and 30th, and again on October 24th, two samples of air were collected, one just before the traffic was stopped at midnight and the other early in the morning, after the tube had been ventilated by the passage of air and before the morning traffic had commenced.

The following results were obtained on the examination of these samples :—

Date.	Place of Collection.	Time.	Carbon dioxide in volumes per 10,000 volumes of air.
May 16.	Tottenham-ct.-rd. Station	12.10 midnight	8·6
Do.	Do.	5.0 am.	6·8
May 30.	Chancery-lane Station	12 5 midnight	7·4
Do.	Do.	4.30 a.m.	4·5
Oct. 24.	Oxford-circus Station	12.10 midnight	10·3
Do.	Do.	4.35 a.m.	4·4

The results obtained from the samples collected in the early morning show that the ventilation on May 16th was not satisfactory, but that on May 30th and on October 24th a very fair condition of the air in the tube was produced by the ventilation, although the condition of the air was still somewhat inferior to that of the outer air.

The results of both the chemical and the bacteriological examination, which extended over a considerable period of time, has supplied information not hitherto obtained. It is undoubtedly desirable that an investigation of this character should be extended to other underground railways, and that a further examination of the air of the Central London Railway should be carried out when the promised improvement in the system of ventilation has been made.

It will be noticed that about 22 per cent. of the samples collected contained less than twice as much carbon dioxide as that found in outside air, and that 34 per cent. contained less than two and a half times as much. These results were obtained under the present system of ventilation. But it is certainly desirable to adopt a system which gives more uniformly satisfactory results.

I am of opinion that samples of air taken at any point on the railway should not contain more than eight volumes of carbon dioxide in 10 000 volumes of the air, that is, not more than twice the amount which is generally found in the air in the streets.

This standard of purity is suggested in view of the fact that all the additional carbon dioxide found in the air of the tunnel has been produced by respiration, and is, therefore, of a more objectionable character than that produced by the combustion of fuel in the locomotives on other underground railways, or by the combustion of gas or oil for lighting purposes.

The general results of Dr. Frederick Andrewes's investigations are summarised in the following propositions :—

(1.) Micro-organisms were found present in the air of the Central London Railway in a somewhat greater proportion than in the fresh air outside. Taking all the results together, the exact proportion was as 13 to 10.

(2.) The number of micro-organisms found was high in proportion to the concentration of human traffic; highest in the railway carriages, platforms and lifts. Elsewhere I found it low.

(3.) The air of the railway does not, in its bacterial content, compare unfavourably with that known to exist in inhabited rooms generally.

(4.) No pathogenic germs, other than those commonly present as saprophytes upon the normal body were detected in such small volumes of the air as could be submitted to analysis under the conditions of the investigation.

(5.) The number of organisms capable of growing at the temperature of the human body was considerably greater in the air of the Central London Railway than in the fresh air, but the excess was due to nonpathogenic sarcinæ and allied species.

(6.) The number of micro-organisms in the air of the railway was found generally proportional to the degree of chemical contamination, but this rule was subject to striking exceptions.

(7.) The species of micro-organisms found were in the main identical with those occurring in the fresh air

Correspondence.

STEEL-FACING OF MEZZOTINT PLATES.

I much regret, since reading Mr. Davenport's paper on Mezzotints, in your *Journal* of last week, that I was unable to accept the invitation of your Council to be present when it was read. Leaving aside many points which it would have been well to raise in the discussion, I do not think that the remarks upon steel-faced copper plates should be allowed to pass unchallenged; the more so as similar remarks are often made on the point.

I say deliberately that with proper steel-facing nothing whatever is lost to a mezzotint plate; and in many cases the steeled-plate gives a finer proof.

It is a matter which might easily be demonstrated at some meeting of your Society.

Mr. Davenport is also much in error as to the number of good proofs which can be obtained even from a steel-faced mezzotint.

FRANK SHORT.

56, Brook-green, W.,
July 7, 1903.

Journal of the Society of Arts,

No. 2,643. Vol. LI.

FRIDAY, JULY 17, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

The results of this year's Examinations (Grade II.) are now ready. Copies for gratuitous distribution to each candidate who attended the examination have now been sent to each centre. Additional copies can be obtained, price 6d. each.

The Grade I. results will be issued about the end of the month.

The dates for the Examinations in 1904 (Grade I. Elementary, and Grade II. General) will be March 21, 22, 23, and 24. The last day for receiving entries will be February 24.

PRIZE FOR A DUST-ARRESTING RESPIRATOR.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Prize of a Gold Medal, or Twenty Pounds, for the best Dust-Arresting Respirator for use in dusty processes, and in dangerous trades.

The Council are well aware that for many years past the necessity for such an apparatus has been recognised. As far back as 1822 the Society awarded its Gold Medal to Mr. J. H. Abraham, of Sheffield, for a Magnetic Guard to protect persons employed in dry grinding. The apparatus described in the Society's "Transactions" (Vol. 40, 1822, page 135) includes a Respirator to cover the mouth and nose. This Respirator was fitted with magnets, for the purpose of arresting the fine particles of steel thrown off in the process of pointing needles, and in other processes of dry grinding. Although the invention was greatly appreciated at the time, it appears never to have come into practical use, the main objection to it having been, it is believed, raised by the workpeople themselves, who feared that the lessened risk attached to their employment would lower their wages. Similar considerations have, it is believed, stood in the way of the introduction of various appliances intended to limit the risks associated with all trades in which the workpeople breathe a dusty atmosphere. The Council however, think that such considerations are likely to have less weight at the present time, and they hope that the offer of a prize may draw the attention of inventors to the matter, so that it may result in the production of some suitable piece of apparatus, despite the difficulties with which the solution of the problem is surrounded.

The apparatus will be required to fulfil the following conditions:

(1.) It must be light and simple in construction.

(2.) It should be inexpensive, so as to admit of frequent renewal of the filtering medium or of the Respirator as a whole; or alternatively it should be of such construction that it can be readily cleaned.

(3.) It should allow no air to enter by the nostrils or mouth except through the filtering medium.

(4.) It should not permit expired air to be rebreathed.

(5.) The filtering medium, though it should be effective in arresting dust particles, should not offer such resistance as to impede respiration when worn for some hours under the actual conditions of work.

(6.) It is desirable that it should be as little unsightly as possible.

It should be noted that the prize is offered for a Respirator intended merely to arrest dust, and not for a chemical Respirator designed to arrest poisonous fumes. The applications of such chemical Respirators are more limited, and there are special requirements connected with them. The Council have, therefore, preferred to limit the range of their present offer to the simpler and more important cases of dust, either dust of all kinds or of some special character, *e.g.*, iron or steel.

Inventors intending to compete should send in specimens of their inventions not later than 31st December, 1903, to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C. Such specimens must be accompanied by full descriptions, and in cases in which the

apparatus has been put into actual use, the experience of such use should be given.

Competitors intending to patent their inventions should be careful to obtain protection, as the Council of the Society cannot undertake any responsibility as regards the secrecy of the whole, or of any part, of an invention submitted to them.

The Prize will be awarded on the report of judges appointed by the Council.

The Competition is not limited to British subjects.

The Council reserve to themselves the right of withholding the Prize, of extending the time for sending in, or of awarding a smaller Prize or smaller Prizes.

NOTES ON THE PORTS AND HARBOURS OF PENINSULAR INDIA.*

By Horace Bell, M.Inst.C.E.

Among the great problems in these days of keen competition for a market for produce, not the least is that of the reduction of cost of transit. It is the note we constantly hear from the trader, whether in Europe or in America; it is the cause of railway combinations, shipping and other trusts, and the motive leading to maritime canals and new docks and harbours. In no country is this great question of more importance than in India. The area from whence the bulk of its produce is drawn lies in a comparatively narrow belt along the southern slopes of the Himalayas, and in the river valleys originating from that giant chain, and the average distance which the produce of this area must face in order to reach the seaboard may be put at scarcely less than 600 miles.

The wheat and cotton districts of Central India and the Central Provinces are somewhat better off in this respect, but their average distance to the coast cannot be much less than 300 miles. We have to turn to America for similar figures, but the produce is further handicapped by a much longer sea transit, and the heavy weight of Suez Canal dues. On the other hand, our Indian Empire can claim advantages of the utmost value in th struggle, viz., that it has a Government wit practically autocratic control of its publi works, and a system of finance which, if want ing in enterprise, is at any rate eminently saf and the country is thoroughly solvent.

Now, much as has been done withi the last half-century in the constructio of roads, railways, and irrigation canal towards putting the Indian producer in position to compete in over-sea markets, bu little progress has been made towards th creation of new outlets or harbours along th vast Indian seaboard, extending as it does without including the Aracan and Burmes coasts, to well over 3,000 miles. To those wh are mainly familiar with our own English sea board, or with that of the nearer Europea countries across the Channel, the idea "ports and harbours" will be that of place where vessels, whether of small or larg draught, can find shelter in all weathers where they can load or discharge alongsid wharves, and where, at least, small and urgen repairs can be carried out. If we take th English coast line from Newcastle roun to Carlisle, a distance of perhaps about 1,50 miles, we shall find at least twenty-five suc ports, nearly all of which can be entered an left in all weathers, and many of which wi accommodate the largest vessels afloat, an are provided with wet and dry docks, cranes and warehouses, and, in a word, every facilit for dealing with business quickly and cheaply

If we turn now to India, it will be necessar to define a "port" as a point which is an out let or inlet for trade, and may be a mere ope roadstead, whereas for "harbours" we wi assume the meaning just given for Englis ports and harbours.

Dealing only with the peninsula of India if we look for harbours, we shall have to allov that on its vast seaboard, we have only thre places in British territory which would answe to this description, for we must unfortunatel omit Madras from the list. The three in orde of importance as to volume of trade, ar Calcutta, Bombay, and Karachi. One migh at first sight regard this fact as rather dis creditable to our 150 years' tenure of India but there are many reasons, some good and many bad, to account for this state of things Calcutta and Bombay have been noted harbour from time immemorial. Karachi can carry it record back to the days of the fleet of Nearchus but until it was taken in hand by Sir Charle Napier, after the conquest of Sind, it wa

* Mr. Horace Bell, the well-known engineer, whose death on the 10th of April last was recorded in the *Journal* (see *ante*, p. 531), was engaged in collecting materials for a paper on the need for more ports in India, and by permission of Mrs. Bell, the notes for this paper (as he left them) are now published. Two previous papers by Mr. Bell, read before the Indian Section, were published in the *Journal*, viz., "Railway Policy in India" (April, 1898, vol. xlvi. p. 529); "Railways and Famine" (February, 1901, vol. xlix. p. 290).

nothing better than a poor shelter for small country craft, and must have been very difficult to enter in the S.W. monsoon. It can now accommodate vessels drawing 27 feet.

Up to at least forty years ago the trade of India was carried on wholly by sailing ships. The writer remembers that when he landed in Calcutta in 1862 from a sailing liner of about 800 or 900 tons, there was not a single seagoing steamer in the river; there were no moorings, and vessels cast anchor at a point indicated by the Harbour Master, and then lay for weeks or months waiting for a cargo, which was slowly accumulated, and still more slowly put on board from lighters in the stream. The largest vessel that then came up the Hooghly could not have been much over 1,000 tons register. The Suez Canal and the creation of an extensive railway system has changed all this. Calcutta is now provided with jetties, wet docks, graving docks, warehouses, hydraulic cranes, and every appliance for dealing with a large trade. The Hooghly is expected, and that most unfairly, to take vessels of from 25 to 27 feet draught, and has been cruelly maligned as a deteriorating river owing to the difficulty and danger of the channels for vessels of this size. The question of improving the navigation has been dealt with in reports from experts of all kinds for the last twenty years, but nothing serious has been as yet attempted in the shape of action. It is perhaps well that this is so, for the *régime* of a deltaic branch of a great river like the Ganges, which in flood carries an enormous amount of silt, is one of constant and unlimited changes, while the problem is greatly complicated by the effects of the junction of the Roopnarain river between Calcutta and the sea. Of late years, the proposal to adopt the Muttah, an older and more stable deltaic outlet, as the line of access to Calcutta, and connecting them by a ship canal, seems to be a reasonable and feasible project; but apart from the heavy additional charge that this would involve on the shipping using it, the smaller craft would still use the Hooghly, and it is consequently doubtful if it would pay interest on the outlay. Yet it may be taken as an axiom of the present day that, assuming cargo can be got, and rapidly, the larger the vessel is, the better it pays, and the enormous size of our Atlantic liners is a good illustration. Thus it would seem that if Calcutta is to keep its present prominence, and meet the steady growth of the Indian trade, it must either go to the Muttah for a channel, or make a port lower down, and nearer the sea, on the Hooghly.

It is necessary to explain why Madras must be excluded from our small list of harbours. There is a harbour at Madras certainly, but unfortunately it is practically useless, if the definition given above is to be applied to it. The history of Madras, as a port of any importance, dates no further back than to the days when we selected the place as a trading settlement, and built Fort St. George, in 1639. It was then—and it is scarcely better now—an open roadstead, liable to be swept by storms or hurricanes of intense violence, when every vessel that could venture on the process had to go to sea for safety and a good offing, as indeed is the case at the present day. Our first record of a Madras cyclone is of that of 1746, after the Fort had surrendered to La Bourdonnais, when the French fleet, with its prizes (our vessels) was almost destroyed. Five of the French vessels and two prizes foundered, with the loss of 1,200 men, and scarcely a ship escaped with its masts standing. Since then many a good ship has met the same fate on this coast, for no shelter port exists, even to the present day, between Trincomali, in Ceylon, on the south, and Diamond Harbour, on the Hooghly. The present "harbour" has been, so to speak, built out from the sandy foreshore. It was commenced in 1876, and when approaching completion in 1881, it was attacked by a severe cyclone and very seriously damaged. It has remained practically in this condition until now, and during this period the sand has encroached so far on the southern flank as to threaten to enter the harbour. The subject of reconstruction has been anxiously considered for many years, but beyond altering the entrance to the north-east corner there would seem to be very little hope of materially improving the place. The idea of a vast breakwater outside the harbour is, we understand, now under consideration; but, apart from the problematical value, the cost of such a work would involve charges on the shipping which might seriously affect the trade of the place.

The scheme of Indian railways sketched out by the master mind of Lord Dalhousie, in 1853, naturally took the two ports of Calcutta and Bombay as the starting points for the trunk lines, and this *motif* has been naturally followed by his successors with the result that it has necessarily influenced the general features of the system as it now stands. In later years, the needs of the Punjab led to the

improvement and consequent steady growth of Karachi as an outlet for Northern India; and, placed as it is with about one day's saving in distance from Aden, it seems destined in the future to become a formidable rival to Bombay. Thus the bulk of the export and import trade of British Peninsular India is dealt with at three points only, if we exclude Madras.

Now, the value of this trade, according to the latest returns, is in round figures about 150 millions sterling, of which about 130 millions is private trade. Of this, about 106 millions is dealt with at Calcutta, Bombay, Madras, and Karachi, and the balance at the Burma ports and Chittagong, and the numerous small ports round the coast. To this we have to add the coasting trade, which is necessarily focussed to a large extent on the principal harbours. The value of this trade in 1900-1901 is put at 55½ millions sterling. It is largely carried on by native craft, and also by steamers of moderate size and draught, and at the numerous ports, other than the principal ones, above mentioned, the trade has to be dealt with entirely by lighters from the shore, in some cases for three or even four miles of open sea, and the cost of this and of insurance and loss of life and vessels, must necessarily imply a severe loss to the producer, as compared with the facilities of an up-to-date harbour.

But while we may deplore the want of more first-class outlets for our Indian trade, we must not ignore the fact that the physical configuration of the Indian coasts, the climate and meteorological conditions, and comparatively small tidal range, render it no very easy matter to select new sites.

Great Britain is peculiarly favoured in this respect. Its coasts have a large tidal range, it has many tidal estuaries which are natural harbours, its rivers, unlike those of India, have a comparatively even discharge taking the year round, and few of them carry anything approaching the volume of sand and silt which is carried by Indian rivers in times of flood. Nevertheless, as we shall show further on, there are at least two sites where excellent harbours could be created, and where they would afford incalculable benefit both to the producing and shipping interests. It cannot, of course, be argued that the present three principal ports will be unable to deal with the rapidly-increasing trade. Their Port Trusts are managed by most vigorous and capable Commissioners, keenly and closely interested in their ports, and they probably and not unnaturally have no particular desire to support or assist in any way the creation of new and rival outlets.

But the time has come for a serious consideration of this question, more especially in the interests of large areas in the south which, of late years, have been endowed with the boon of railway connection with Central and Upper India. It is surely a grievous anomaly at the present day, if it is not a discredit to our administration of the country, that the whole sea-borne trade of Southern India has still to be dealt with in open roadsteads, or what is practically the same thing, and that along the whole length of the Coromandel Coast there is not a single harbour where a large, or even a small vessel, can run for shelter or repair in bad weather. More than this, on this coast we are in no better position in the event of a great naval war then we were about a hundred years ago, when the Bay of Bengal was for several years the happy hunting ground of French frigates.

Where, in this long stretch of 1,500 miles, is there a place for the concealment, the coaling, the repair of our cruisers? There is no such place from Colombo to Calcutta, and between them lies a region in which severe cyclonic storms may be expected for six months in the year.

I must not, however, be misunderstood as to the value and importance of many of the coast ports, which may be termed "secondary" ports, as compared with the three principal harbours. At many of these, as for instance on the east coast, the roadsteads of Madras, Bimlipatam, Vizagapatam, Negapatam, and Tuticorin, and on the west coast, the ports of Cochin, Beypore, Cannanore, Mangalore, and perhaps Broach, do no inconsiderable trade by direct shipment to and from European and other distant ports, but vessels of large size must lie a long way off-shore, and at certain seasons, in the monsoons, these ports are practically closed to them. Even in the fair season the swell is generally considerable, and the loading and unloading by lighter or surf-boat involve risks to cargo, besides the detention of vessels. There can be little doubt, both from reports made to Government, and from observations made by the writer on journeys along the coast, that the obstacles now existing at many of the coast ports could be materially reduced by moderate yet systematic expenditure by provincial Governments or by the Government of India; and at two points, one on the east and the other on the

vest, there is no doubt that first-class harbours ould be created, viz., at Vizagapatam and .t Cochin.

Vizagapatam has long been recognised as he future site of a harbour and outlet for the rade of the Central Provinces, and as the ailway to the north joining it with Raipore is :ertain to be made within the next few years, he importance of the place cannot be much onger ignored. It has, of course, been surveyed ınd reported upon over and over again during he last twenty or thirty years by engineering, ıautical, and mercantile experts, and the ›pinion of all is that, given a moderate igure of outlay, less than a million sterling, ι first-class shelter harbour could be made ıt this place, while in the backwater quays, locks (wet and dry), warehouses, and work-shops could be erected in complete shelter rom weather, or from direct attack of an enemy. The creation of a port for ocean-going vessels at all seasons would make Raipore a principal mart in the Central Provinces, within about 320 miles from the seaboard, whereas its present outlets are Calcutta (513 miles) and Bombay (700 miles). The new port would serve a large part of the trade dealt with by the East Coast Railway, and obtain no inconsiderable share of trade to and from the eastern districts of the Hyderabad territory. If the work is carried out gradually and economically, its fiscal success seems assured almost from the outset. A very important physical feature of Vizagapatam, is the lofty headland, the "Dolphin's Nose," the top of which is about 1,500 feet above the sea. As a landfall, it is invaluable, and still more so as sheltering and completely concealing from the sea the shipping in the backwater already referred to. An old battery or fort, now in ruins, s still a feature of this hill, but if a shelter harbour were made, a battery better placed and armed with modern guns should be able to completely protect the harbour from sea attacks.

The other point to which I have referred, viz.: Cochin, on the West Coast, is of a otally different character, and it would seem hat for a comparatively trifling initial outlay, and a moderate annual charge for dredging, access could be obtained to a really magnificent natural harbour, or backwater, which would be large enough to hold the largest naval fleet we are ever likely to need in Eastern waters, with ample room for vessels of any size.

In a report on Indian harbours made to the Government of India, in 1871, by Mr. George Robertson, a harbour engineer of eminence, he says, that by dredging some shallow places, "Cochin is capable of being made the finest close harbour in India. . . . . The backwater, south of Cochin, swells into a magnificent sheet of water. At its southern end it must be fully ten miles wide. It is practically a wet dock of greater area than all the docks in Great Britain put together." All that is needed are training walls and dredging at the entrance, and keeping the channel clear after heavy gales. Dry docks or repairing slips could be cheaply made. There seems to be no doubt whatever that, at a very moderate outlay, a shelter harbour of vast extent, and for large ships, could be created at Cochin. The question of the improvement of the entrance to Cochin Harbour has lately been taken up by Lord Ampthill, Governor of Madras, a matter which has been "under consideration" for half a century at least. Cochin is now served by a branch of the Madras Railway system, while the Travancore-Tinnevelly Railway, now approaching completion, will place Quilon, the terminus, in connection with Cochin by boat, through a chain of backwaters. Cochin would thus become not only a vast harbour of shelter, but the outlet for ocean trade for a great part of Southern India.

The cost of making these two harbours would, we believe, be amply provided for at the outset by a sum of one and a-half million sterling, a sum which will seem ludicrously small when compared with the advantages which they will confer on the agricultural and commercial areas they will serve, while their value to shipping, whether naval or mercantile, cannot be denied for a moment. But it is by no means certain that the outlay need be provided by the State in either case, for the reason that in the hands of a Port Trust or a public company it should not be long after their completion before a very satisfactory return is earned. All that would seem necessary is that the Government should, as in the case of Calcutta and Karachi, advance the sums required at the current rate of interest, while requiring to be represented in the administration of the concerns.

Probably outside pressure of no ordinary character may be necessary to obtain hearty local co-operation. From Madras itself, we must probably anticipate uncompromising opposition from the mercantile community; but in Lord Ampthill we may expect a man of action, who will not be content with

speeches, reports, notes, and estimates, which is about all that has hitherto been done for Cochin during the past half century.

Unless we take prompt and vigorous steps to decrease the cost at port of our Indian produce, we may find that India, even with her great advantage of cheap labour, will, as regards foodstuffs at any rate, see herself shut out from many markets, which will secure their supplies from the American and Canadian seaboards, fed as their ports will be by very alert and capable railway and snipping combinations.

Miscellaneous.

SOUTH AFRICAN TOBACCO.

In continuation of Mr. E. Gould's article on Tobacco Growing at Barberton (see *ante* p. 644), reference may be made to the report of the Committee of the De Kaap Agricultural Society on Tobacco Culture in the De Kaap Valley, which has been published in the *Transvaal Agricultural Journal.*

The Committee, after going thoroughly into the matter, have come to the following conclusions, and make the following recommendations, viz. :—

The Committee find that the replies received by the Society from the different farmers do not fully represent the return of tobacco which can be expected from growers in the valley, and are of opinion that 180 acres will be cultivated, giving a probable return of 150 tons of tobacco, worth £33,000 as a manufactured article, and should the article turn out to be a thorough success, then the Committee are of opinion that the acreage would be increased more than fourfold.

The Committee are strongly of opinion that the erection of a factory in the De Kaap Valley is required for the manufacture, cutting, and general preparation of tobacco.

The Committee would recommend that the Government be most respectfully approached upon the following subjects :

1. That the Government be requested to send the Government analytical land chemist down to Barberton district to sample the soils upon the different farms for the purpose of determining upon the best class of manure for the different varieties of soil.

2. That the Government encourage the importation of manure by private enterprise, by allowing the same to come into the country free of import duty, and transport at the lowest possible rate over the Government railway lines. Further, the Government itself import manure for the use of the farmers, and supply same to them at as near cost price as possible. That the Committee desire to point out that the cost of manure imported is very high, and should be greatly reduced.

3. That the Government be requested to grant a building site in or near to Barberton, for a factory, with the special stipulation that the site granted be only used for the erection of the factory building, and not for residential or cultivating purposes. Ground to revert to Government should the factory be shut down.

4. That the capital necessary for the erection of the factory and appurtenances be provided from private sources, with a five years' guarantee from the Government if a return of 8 per cent. be made good by the Government. The guarantee from Government to be inoperative unless the factory is working.

5. Should the foregoing not be acceptable that then the Government be requested to offer a bonus on the growth of tobacco, to encourage the industry.

6. That a protective duty of sixpence per pound be levied on all tobacco imported from and grown in the neighbouring Colonies. Those Colonies having State-aided labour (coolie) are enabled to work cheaper than the Transvaal Colony and produce tobacco at a cheaper rate.

7. That special attention be given to Government experimental farms, and that the Government be urgently requested to have such a farm started in De Kaap Valley for the advancement of the tobacco industry.

8. That should suggestions be entertained, then as much advantage as possible be taken of local talent and experience in the appointment of overseers and to carry on the venture in this district, and further, that steps be taken to protect the industry, by the appointment of an inspector of the Transvaal tobacco, so as to at once put a stop to the sale of large quantities of inferior tobacco grown in and sold under the bands of this Colony, and thus damaging the reputation of the industry. Since the earliest days of the Transvaal this country has had the reputation for producing the best tobacco in South Africa.

RUSSIAN GOLD AND SILVER WORK.

For centuries Russia has been famous for the beauty and design of its manufacture of gold and silver ornaments. As far back as the eleventh century ancient literature shows that an abundance of beautiful articles existed in gold and silver, such as rings, earrings, vases, ornaments, and arms. It was not, however, until the twelfth century that the working of silver and gold became a national industry. In the fifteenth century the art had so far advanced in all that concerns metal articles, cast or forged, as to cause the establishment of workshops for the manufacture of embroidery, tinsel ware, gold beating, and the regular goldsmiths' work. The organisation of the craft and the first legal regulation of the gold and

silver industries date from the end of the eighteenth century. Following the example of the States of Western Europe, the basis of this new regulation was an obligation not to manufacture any articles other than of a good alloy, not to sell any articles which had not been tested by the State, and to pay a very small duty or tax called the "control tax." These regulations are still in force. The great favour always enjoyed by Russia in gold and silver articles, as well as the measures taken by the Government with a view of promoting the prosperity of this industry have assured and successfully developed it. In the actual situation of the gold and silver industry, by the variety of its products, the importance of its manufactures and the operations to which it gives rise, the first place belongs to that Russian manufacture called high-class ware, as well as to the goldsmiths' trade in the broadest acceptation of the term. This branch of industry produces articles of forms and qualities much varied, of articles cast, forged, chiselled, engraved, chased as well as cloisonné, of articles of oxydised metal, and lastly of enamels, which it is claimed have no rivals. The larger articles and partly the small ones also, have for a long time past been manufactured at Moscow, St. Petersburg, Warsaw, Odessa, Riga, at Koono and Berdicher, in factories and simple workshops. The smaller articles are manufactured chiefly by the artisans in the large towns and by workers in families in the provinces of Kostroma, Moscow, and partly by the goldsmiths in the provinces of the Caucasus. The United States Consul at Odessa says that articles in filigree, purses, ear rings, pins, belts, &c., are manufactured by goldsmiths, and sometimes by artisans working at their homes in the Caucasus. The second branch, which is the most important one in the Russian gold and silver industry, is the manufacture of tinsel. The production of tinsel, which makes great progress, comprises most varied articles. It furnishes the materials for an entire series of industries, such as gold embroidery, gold lace, galloon, or crown lace and brocade. This industry is almost entirely centered at Moscow and its neighbourhood. Owing to the importance and extent of its production, gold beating comes next after the tinsel industry. This branch of industry produces under the name of "folier" extremely thin foil of forged metal, which is employed for gilding and silvering certain articles, and in the tinsel industry. The principal centres for the production of "folier" are the towns of Moscow and St. Petersburg, and the province of Yaroslav. Watches with gold or silver cases, as well as other articles of precious metal subject to the rules of good alloy, and Hall-marking and "control tax," are not manufactured in Russia. Moscow occupies the first place for the kind, character and importance of the production of gold and silver articles. This town alone produces 38·3 per cent. of the gold articles of various kinds, and 59 per cent. of the silver articles manufactured in the empire. After Moscow comes St. Petersburg. Following the two capitals, the following cities range in the order of importance of their productions: Odessa, Warsaw, Riga, Tiflis, and the region of Kostroma. Other places having an important production are Vilna, Kazan, Toula, Ekaterinoslav, and Ekaterinburg. All of the gold and silver used in the trade in Russia is imported in ingots from Hamburg.

COPE COLLECTION AT THE VICTORIA AND ALBERT MUSEUM, SOUTH KENSINGTON.

The bequest of the late Mr. W. H. Cope is now exhibited in the Cross Gallery, adjoining the Indian Section, and forms a most valuable addition to the Oriental collections of the Museum. Mr. Cope made his collection with great care and judgment, and many of the specimens were acquired at the dispersal of the works of art of well-known collectors. Very fine examples of carvings in jade, crystal, and other stones from China and India, fill the first case; amongst them may be noted a crystal bowl and a crystal tea-pot, enriched with stones, in gold, and flowers composed of rubies, emeralds, and diamonds. On the top shelf in the same case are a pair of dark green jade candlesticks, carved with flowers. The mandarin's rosary suspended at one end is a beautiful work of art. The next case is devoted to a miscellaneous collection of lacquer work, Chinese enamels, and Japanese netsukés, mostly little ivory groups wonderfully carved. The third case contains a collection of glass, amongst them being some tall Venetian wine-glasses, with stems of marvellous shape, which Mr. Cope acquired at the Magniac sale. In this case likewise are some dark blue glass flagons with painted ornament, formerly in the famous Bernal collection. Specimens of Chinese porcelain fill the two remaining cases and form in themselves quite a representative collection. There are examples of biscuit-body vases of the *famille verte*, and wine pots in the form of mythical lions; bottles and jars with blue and white decoration; vases with splashed glazes, hitherto unrepresented in the Museum; a very rare powdered blue bottle in the form of a triple gourd, enriched with polychrome flowers in white panels; and a very considerable collection of egg-shell cups and saucers and plates of the Chien-lung period (1736-1795), most delicately painted with flowers and figures.

Notes on Books.

A Catalogue of the Armour and Arms in the Armoury of the Knights of St. John of Jerusalem, now in the Palace, Valetta, Malta. By Guy Frances Laking, M.V.O., F.SA., Keeper of the King's Armoury. London: Bradbury, Agnew and Co.

The first record of the Armoury of the Knights of

St. John after their occupation of Malta is dated 1531, the year after the Emperor Charles V. invested the Order with the complete and perpetual sovereignty of the island. This relates to a gift of artillery sent by Henry VIII. in fulfilment of a promise made to the Grand Master in 1526, when L'Isle Adam visited this country. This gift formed the nucleus of the collection, which grew very rapidly, one of the rules of the Order being that any weapon or armour found upon a deceased knight became at once and indisputably the property of the Order.

With the close of the 18th century the Armoury lost much of its ancient glory. Napoleon transferred some of its treasures to Paris, and when Malta came under British Government much of the old armour was thrown aside as useless lumber to make room for modern armaments. Sir Gaspard Le Marchant, the Governor from 1858 to 1864, set himself the task of re-organising the Armoury. A thorough re-arrangement has been made of late, and the collection is now in a highly satisfactory condition. The author remarks respecting the character of the armour in the collection, "Amongst the 5,721 pieces which it contains, there is now not one single forgery—an assertion it is safe to say, which scarcely one armoury in Europe dare venture to put forward. It is true that a certain number are inferior in quality, and can hardly be considered by the collector as good specimens of the armourer's craft, but they are all *true* pieces, and have acted the part in history for which they were intended, and for this reason should not be passed over as coarse or ugly, or because they fail to please."

The catalogue is fully descriptive of the objects, and well illustrated. There is a plate of the sword presented by Philip II. of Spain, to the Grand Master, La Vallette, after his successful defence of Malta against the Turks, in 1566. The hilt is of gold, enriched with translucent enamels, and set with jewels. The sword is now in the Bibliotheque Nationale, Paris, where it is known as the "Epée de la Religion."

The Ventilation, Heating, and Management of Churches and Public Buildings. By J. W. Thomas, F.I.C., F.C.S. London: Longmans.

The author points out the prevailing errors in the ventilation of churches, halls, schools, and other public buildings, and shows how the ventilation of buildings already erected can be improved. After explaining as the result of experiments the action of wind on ventilation, the effects of moist air, &c., he points out the way to apply the principles thus obtained to the ventilation of new buildings. The last chapter is devoted to instructions for the caretaker, upon whom so much depends in the proper management of the facilities at his disposal.

Pitman's Business Man's Guide. A Handbook for all engaged in Business. London: Sir Isaac Pitman and Sons.

This is an alphabetical dictionary of commercial information needful to business men, which is put forward in a very convenient form. Besides commercial terms and phrases (for which French, German, and Spanish equivalents are in all cases given) there are references to the chief countries of the world, and many geographical particulars.

Pitman's Shorthand Teacher's Handbook. London: Sir Isaac Pitman and Sons.

The author attempts to provide teachers with such practical information as may be a help to them in the improvement of teaching methods. A succession of chapters are devoted to an explanation of the various courses of lessons.

Obituary.

Sir Joshua Fitch, LL.D., the well-known authority on the theory and practice of education, died on Tuesday, 14th inst., at his residence, 13, Leinster-square. He was born in 1824 and graduated M.A. at the London University in 1852. In 1856 he was appointed principal of the Training College of the British and Foreign School Society, and in 1863 he was appointed an Inspector of Schools, a position he held for 31 years. From 1865 to 1867 he was detached for special work as Assistant Commissioner to the Schools' Inquiry Commission. In 1869 he was appointed a Special Commissioner on Education in the great towns, and from 1870 to 1877 he was an Assistant Commissioner of Endowed Schools. Mr. Fitch received the honour of knighthood in 1896. He contributed a sketch of English educational history and progress to the Supplement of the "Encyclopædia Britannica," and also published, "Lectures on Teaching," delivered before the University of Cambridge; "Notes on American Training Schools and Colleges, 1887; "The Arnolds and their Influence on English Education," and "Educational Aims and Methods," a volume of lectures and addresses. Sir Joshua Fitch acted as Examiner in English for the Society of Arts from 1885 to the time of his death, and was a member of its Examination Committee. In 1901 he read a paper on "School Work in Relation to Business," for which he received the Society's silver medal.

General Notes.

Exhibition of British Engraving and Etching.—As the collection of examples of British Engraving and Etching brought together in the Galleries of the India Section of the Victoria and Albert Museum continues to attract many visitors, the Board of Education have arranged that it shall remain open until the 30th September next.

Journal of the Society of Arts,

No. 2,644. Vol. LI.

FRIDAY, JULY 24, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

PRACTICAL EXAMINATIONS IN MUSIC.

The practical examinations in Music were not concluded this year until the 4th July, too late for the results to be included in the Report of the Council. They lasted for 10 days.

The examination was conducted by Mr. Ernest Walker, M.A., MusDoc.Oxon., and Mr. Burnham Horner.

The system of examination was the same as that for recent years. For intrumental music certain standards are given, and candidates are asked to select for themselves which of these standards they choose to be examined in. The standards range from easy to very difficult music. For each standard a list of music is given for study, and from this list candidates select the pieces they will sing or play. Candidates are expected to play or sing the pieces which they have prepared, to play or sing a piece, or portion of a piece, at sight, and to play certain scales.

In all, 501 candidates entered, and of these 486 were examined, an increase of 89 as compared with last year; 8 of these took up two subjects, so that there were 494 examinations. Of these there were 418 passes and 76 failures.

The following were the subjects taken up:—Piano, singing, violin, violoncello, viola, and organ. 408 entered for the piano, 347 of whom passed; 60 entered for the violin, of whom 49 passed; 2 entered for the violoncello, both of whom passed; 3 entered and passed for the organ; 20 entered for singing, of whom 16 passed; 1 entered and passed for the viola. No medals were awarded.

The tests were, perhaps, slightly severer than heretofore, so as to give greater value to the certificates. The examiners would press upon the notice of teachers the necessity of special attention to the development of good touch and tone. They also remark that many candidates do not play their pieces at the full proper speed; but they do not wish to encourage acceleration of pace at the expense of other important considerations.

Proceedings of the Society.

CANTOR LECTURES.

HERTZIAN WAVE TELEGRAPHY.*

By Dr. J. A. Fleming, F.R.S.

Lecture I.—Delivered March 2nd, 1903.

General Principles. The Theory of the Radiator or Aerial.

When the request reached me six months ago to give a course of Cantor Lectures on Wireless Telegraphy, my first feeling was that the subject had been treated so fully and frequently, not only in lectures by leading authorities and pioneers, but in countless magazines and other publications, that there was very little left unsaid upon it. On the other hand, it was represented to me that there is still a demand for information on a subject which stimulates the public interest in a manner no other practical application of science of late years has effected.

The popular magazines have supplied non-technical readers with light information about the subject, but not with much scientific explanation.

The numerous and valuable communications which have been made from time to time to this and other institutions by various distinguished inventors, have dealt with special sides of this subject, and with their own individual achievements. There seemed room, however, for a more general summary of one particular branch of it, which should bring to a focus information existing in various scientific papers and specifications, and it is that task which will be attempted in the following lectures.

As indicated by the title, the lectures will, however, be limited to the consideration of that variety of telegraphy without continuous wires, in which Hertzian electric waves are employed. Without in the least desiring to undervalue

* The blocks illustrating these lectures have been kindly lent by the Proprietors of *Engineering*.

the work which has been accomplished during the past fifty years, in the applications of electric conduction, electro-magnetic induction, electrostatic induction, or other electrical facts and principles in this department of telegraphy, I think it will be conceded, in view of the recent remarkable achievements of Mr. Marconi, in accomplishing long distance wireless telegraphy, that Hertzian wave telegraphy has the foremost claim on our attention, at the present time. I do not propose to deal, therefore, with the development of the art of wireless telegraphy as a whole, nor even to attempt to mention all the contributions made to this one branch of it by numerous inventors.

Moreover, although the names of prominent inventors are necessarily mentioned, this is not to be interpreted as a dogmatic definition of their position in the difficult and delicate questions of priority; neither is the absence of the name of any inventor to be taken as indicating disregard for his contributions to discovery or knowledge, but only that the limitations of space preclude exhaustive statements.

Our attention will be mainly directed to the nature of the appliances which have been perfected for the utilisation of electric waves of the Hertzian type, as a means of communicating intelligence from one place to another, and to the theory of their operation. In so doing, an initial acquaintance with the subject of electric waves will be presupposed. Two years ago I had the pleasure of giving a course of Cantor Lectures, in this room, on "Electric Oscillations and Electric Waves," to which the present lectures must be considered as supplementary. Time will not allow me to recapitulate here all the elementary facts contained in that previous course. They can be consulted in print by those who desire to do so.

The practical problem of electric wave telegraphy, which has been variously called spark telegraphy (Funkentelegraphie), Hertzian wave telegraphy, or Marconi telegraphy, is that of the production of a continuous or intermittent train of long electric waves, which can be sent out from one place, controlled, or cut up into long and short trains, or groups of trains, detected at another place, and interpreted into an alphabetic code. Up to the present time, the chief part of that intercommunication has been effected by the Morse code, in which a group of long and short signs form the letter or symbol. Some attempts have been made, with more or less success, to work printing telegraphs, and even writing or drawing telegraphs by Hertzian waves, but they have not passed beyond the experimental stage, whilst wireless telephony by this means still occupies the thoughts of inventors.*

We have therefore to consider in the first place the transmitting arrangements, and, incidentally, the nature of effect or wave transmitted; in the second place, the receiving appliances, and the last lecture will be devoted to the discussion of some of the problems connected with the conveyance of intelligence between any two places.

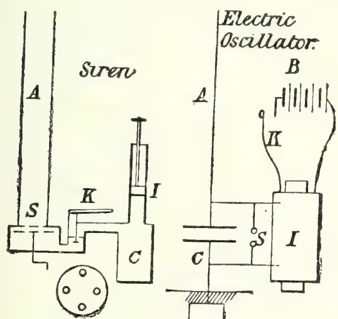
The transmitter consists essentially of a device for producing electric waves of a type which will travel over the surface of the land or sea without speedy dissipation, and the important element in this arrangement is the radiator, by which those waves are sent out. I propose to devote this first lecture to a discussion of the general principles and the theory of the radiator, and then to occupy the next with the details of the transmitting appliances.

It will probably assist you most easily to arrive at a general idea of the functions of the various portions of the transmitting arrangements, and, in particular, of the radiator, if we begin by developing the analogy which exists between electric wave generation for telegraphic purposes and air wave generation for sound signal purposes. You have all probably visited some of the large lighthouses which exist round our coasts, and have there seen a steam or air siren as used for the production of sound signals during fogs. If you have examined this appliance, you will know that it consists, in the first place, of a long metal tube generally with a trumpet-shaped mouthpiece, A (see Fig. 1). At the bottom of this tube there is a plate, S, with holes in it, against which revolves another similarly perforated plate. These two plates separate a back chamber, or wind chest, from the tube, and the wind chest communicates with a reservoir of compressed air, C, or a high pressure steam boiler. In the communication pipe there is a valve, K, which can be suddenly opened for a longer or shorter time. When the contiguous plates revolve, the coincidence or non-coinci-

* The recent interesting experiments made by E. Ruhmer, of Berlin (see *Elektrotechnische Zeitscrift*) in the transmission of articulate speech by means of rays of light are, however, a step in the right direction. Availing himself of the well-known property of selenium, of altering its resistance by light, Ruhmer is said to have made an improvement on Graham Bell's photophone, by means of which he has transmitted articulate speech over a distance of 7 or 8 kilometers without wires.

dence of the holes in them opens or shuts the passage way very rapidly. Hence when the blast of air or steam is turned on, the current is cut up by the revolving plates into a series of puffs, which fall as blows upon the stationary air in the siren tube. If these blows come at the rate, say, of a hundred a second, they give rise to aerial oscillations in the tube which impress the ear as a deep musical note or roar, and this continuous sound can be cut up by closing and opening the valve intermittently into long and short periods, and so made to signal a letter denoting the name of the lighthouse. In this case the object is to produce, first, aerial vibrations in the tube giving rise to a train of powerful air waves; secondly, to intermit this wave-train so as to

FIG. 1.



COMPARISON BETWEEN A SIREN AND AN ELECTRIC RADIATOR OR OSCILLATOR.

produce an intelligible signal; and thirdly, to transmit this wave as far as possible through space.

The production of a sound or air wave can only be achieved by administering a very sudden blow to the general mass of the air in the tube. This impulse must be of a character to call into operation the inertia and elastic qualities of the air. It is found, moreover, that the amplitude of the resulting wave, or the loudness of the sound, is increased by suitably proportioning the length of the siren pipe and the frequency of the air puffs, whilst the distance at which it is heard depends also in some degree upon the form of the mouthpiece.

Inside the siren tube when it is in operation, the air molecules are in rapid vibratory motion in the direction of the length of the tube. If we could at any one instant examine the distribution of air pressure in the tube, we should find that at some places there are large variations in air pressure, and at others small variations. These latter places are called the *nodes* of pressure. Also at other places we should find large variations in the velocity of the air particles, and these are called the *antinodes* of velocity. In those places at which the pressure variation is greatest, the velocity changes are least, and *vice versa*. Outside the tube, as a result, we have produced a hemispherical air wave, which travels out from the mouthpiece as a centre, and if we could examine the distribution of air pressure and velocity all through all external space, we should find a distribution which is periodic in space as well as time, constituting the familiar phenomenon of an air wave.

We can find the analogues of all these parts and organs of a sound or air wave-producing siren, in the electric or Hertz wave transmitter or radiator, as used in Marconi wireless telegraphy. In the first place, instead of air we have the ubiquitous æther. For our purposes, let us consider this as a most subtle kind of atmosphere existing everywhere in space. This æther permits changes to be produced in it, which are analogous to, but not like, the compressions or movements which constitute a sound wave.

The radiator is an appliance for doing to the æther just what the siren does to the air. It produces a wave in it.

To understand the nature of an electric wave, we must consider, in the first place, some properties of the æther. In the æther we can, at any place, produce a state called *electric displacement*, or *electric strain*, which corresponds with compression or rarefaction in air, and just as the latter changes are said to be produced by mechanical force, so the former is said to be produced by *electric force*.

We cannot define more clearly the nature of this electric strain or displacement until we know much more about the structure of the æther than we do at present. We can picture to ourselves the operation of air compression by thinking of the air molecules as brought closer together and as resisting this approximation, but the difficulty of comprehending the nature of an electric wave arises from the fact that we cannot yet resolve the notion of electric strain into any simpler or more familiar ideas.

We have to be content, therefore, to disguise our present ignorance by the use of some descriptive term, such as *electric strain*, *line of electrostatic strain*, *line of electric force*,

Faraday tube, or *dielectric polarisation*, to describe the directed condition of the space around a body in a state of electrification, or which is produced by electric force. This electric strain is certainly not of the nature of a compression in the æther such as we can produce in a gas, but much more akin probably to a twist or rotational strain in a solid body taking place along definite lines.

For our present purpose it is not so necessary to postulate any particular theory of the structure of the æther, as it is to possess some consistent hypothesis in terms of which we can describe the phenomena which will concern us. These effects are, as we shall see, partly states of electrification on the surface, or distributions of electric current in wires or rods, and partly conditions in the space outside them, which we are led to recognise as distributions of electric strain and of an associated effect called magnetic flux, taking the form of a wave motion.

We find such a theory at hand at the present time in the electronic theory of electricity, which has now been sufficiently developed and popularised to make it useful as a descriptive hypothesis. This theory has the great recommendation that it offers a means of abolishing the perplexing dualism of æther and ponderable matter, and gives a definite, and in a sense objective, meaning to the word Electricity.

In this physical speculation the chief subject of contemplation is the electron or ultimate particle of electricity which when associated in greater or less number forms the chemical atom of ponderable matter. The theory postulates the existence of two kinds of electrons, positive and negative, and we have much experimental evidence that we can isolate or detach negative electrons from atoms of matter. We have not yet, however, been able to isolate positive electrons. Hence when we detach one or more negative electrons from an atom of matter the exact nature of the residue left behind is unknown to us, and to avoid further hypothesis concerning it I have elsewhere called this residue the *co-electron*, and we shall adopt the view that a single chemical atom is a union of a *co-electron* with a surrounding envelope or group of electrons, one or more of the latter being detachable. We need not stop to speculate as to the structure of the atomic core or co-electron, whether it is composed of positive and negative electrons, or of something entirely different. The detachable electron is the indivisible unit or atomic element of so-called negative electricity, and the neutral chemical atom deprived of one electron is the unit of positive electricity. On this hypothesis the chemical atom is to be regarded as a microcosm, a sort of solar system in miniature, the component electrons being capable of vibration relatively to the atomic centre of mass. Furthermore, from this point of view, it is the electron which is the effective cause of radiation. It alone has a grip on the æther, whereby it is able to establish wave motion in the latter.*

Dr. Larmor has developed, in considerable detail, an hypothesis of the nature of the electron which makes it the centre or convergence-point of lines of a self-locked æther strain of a torsional type. The notion of an atom merely as a "centre of force" was one familiar to Faraday, and much supported by Boscovich and others. The fatal objection to the validity of this notion as originally stated was that it offers no possibility of explaining the inertia of matter. On the electronic hypothesis, the source of all inertia is the inertia of the æther, and until we are able to dissect this last quality into anything simpler than the time-element involved in the production of an æther strain or displacement, we must accept it as an ultimate fact not more elucidated because we speak of it as the inductance of the electron.

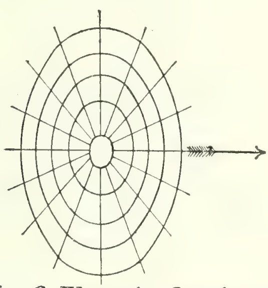
We postulate, therefore, the following assumptions. We have to think of the æther as a homogeneous medium in which a strain of some kind, most probably of a rotational type, is possible. This strain appears only under the influence of an appropriate stress called the electric force, and disappears when the force is removed. Hence to create this strain necessitates the expenditure of energy. An electron is a centre or convergence-point of lines of æther strain of such nature that it cannot release itself. To obtain some idea of the nature of such a structure, let us imagine a flat steel band formed into a ring by welding the ends together. There is then no torsional strain. If, however, we suppose the band cut in one place, one end then given half a turn

* For further information on "The Electronic Theory of Electricity," the reader is referred to an article bearing the above title by the author which appeared in the *Popular Science Monthly Magazine* (U.S.A.) for May, 1902, vol. 61, p. 5, and subsequently was given as a Friday Evening Discourse, at the Royal Institution (see "Proc. Royal Institution," vol. 17, p. 163). Advanced students may be directed to Dr. Larmor's book, "Æther and Matter," *Camb: Univ: Press*, and also to a paper by Sir Oliver Lodge, on "Electrons," in the *Journal of the Institution of Electrical Engineers*, vol. 32, p. 45, 1903.

and the cut ends again welded, we shall have on the band a self-locked twist, which can be displaced on the band, but which cannot release itself or be released, except by cutting the ring. Hence we see that to make an electron in an æther possessing torsional elasticity, would require creative energy, and when made, the electron cannot destroy itself except by occupying simultaneously the same place as an electron of opposite type. Every electron extends therefore, as Faraday said of the atom, throughout the universe, and the properties that we find in the electron are only there because they are first in the universal medium, the æther. Every line of æther or electric strain must therefore be a self-closed line, or else it must terminate on an electron and a co-electron.

So far, we have only considered the electron at rest. If, however, it moves, it can be mathematically demonstrated that it must give rise to a second form of æther strain which is

FIG. 2.



Radii of Electric Strain & Rings of Magnetic Flux round a Moving Electron.

related to the electric strain as a torque is related to a force, or a vortex ring to a squirt in liquid, or a rotation to a linear progression. The æther state which results from the lateral movement of lines of electric strain, is called the *magnetic flux*, and it can be mathematically shown that the movement of an electron, consisting when at rest, of a radial convergence of lines of electric strain, must be accompanied by the production of self-closed lines of magnetic flux distributed in concentric circles or rings round it, the planes of these circles being perpendicular to the direction of motion of the the electron. (See Fig. 2.)

This electronic hypothesis, therefore, affords a basis on which we can build up a theory affording an explanation of the nature of the intimate connection known to exist between Æther, Matter, and Electricity. The electron is the connecting link between them all, for it is in itself a centre of convergent Æther strain; isolated, it presents itself as Electricity of the negative or resinous kind; and in combination with co-electrons or positive electrons, it forms the atoms of ponderable Matter. At rest, the electron or the co-electron constitutes an electric charge, and when in motion, it is an electric current. A steady flux or drift of electrons in one direction and co-electrons in the opposite, is a continuous current, whilst their mere oscillation about a mean position is an alternating current. Furthermore, the vibration of an electron, if sufficiently rapid, enables it to establish what are called electric waves in the æther, but which are really detached and self-closed lines of æther strain distributed in a periodic manner through space.

We have, therefore, to start with three conceptions concerning the electron, viz., its condition when at rest, its state in uniform motion, and its operations when in vibration or rapid oscillation. In the first case, by fundamental supposition it consists of lines of æther strain of a type called the electric strain, radiating uniformly in all directions. When in uniform motion, it can be shown that these lines of electric strain tend to group themselves in a plane perpendicular to the line of motion drawn through the electron, and their lateral motion generates another class of strain called the magnetic strain, disposed in concentric circles described round the electron, and lying in this equatorial plane.

The proof of the above propositions cannot be given verbally, but require the aid of mathematical analysis of an advanced kind. The reader must be referred for the complete demonstration to the writings of Professor J. J. Thomson* and Mr. Oliver Heaviside.†

In the third case, when the electron vibrates, we have a state in which self-closed lines of electric strain and magnetic flux are thrown off and move away through the æther, constituting electric radiation. The manner in which this happens was first described by Hertz, in a paper on "Electric Oscillations treated according to Maxwell's Theory."‡ As this phenomenon lies at the very root of Hertzian wave wireless tele-

* See J. J. Thomson, "Recent Researches in Electricity and Magnetism," chap. I., sec. 16.

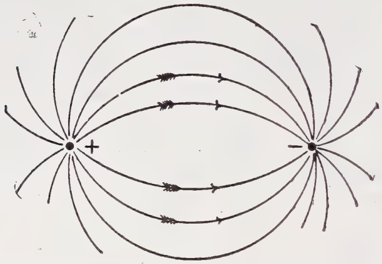
† See O. Heaviside, "Electromagnetic Theory," vol. 1. p. 54.

‡ See "Electric Waves," by Hertz. English translation by D. E. Jones, p. 137.

graphy, we must spend a moment or two in its careful examination.

Let us imagine a short rod terminated by balls, in the form called a linear oscillator, charged with electricity so that one end is positive and the other negative. In the electronic theory, this is explained by stating that there is an accumulation of electrons at one

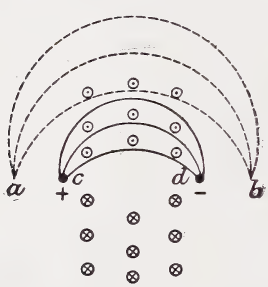
FIG. 3.



Lines of Electric Strain between an Electron – & Co-Electron + at rest.

end and of co-electrons at the other. These charges create a distribution of electric strain throughout their neighbourhood which follows the same law as the lines of magnetic force of a small magnet and may be roughly represented as in Fig. 3. Suppose then that these charges move towards each other and dis-

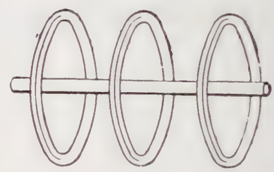
FIG. 4.



Shrinking Lines of Electric Strain producing Rings of Magnetic Flux as Electrons oscillate to & fro slowly.

appear by uniting, the lines of electric strain would collapse, and as they shrink in would give rise to circular lines of magnetic flux embracing the rod. (See Fig. 4.) This external distribution of magnetism is equivalent to a current in the rod produced by the union of the two opposite electric charges. Suppose then the charges reappear in reversed positions, and go through an oscillatory motion. The result in the external space would be the alternate production of lines of electric strain and magnetic flux, the direction of these lines being reversed each half cycle. Inside the rod we have a movement of electrons and co-electrons to and fro, electric charges at the ends of the rod alternating with electric current in the rod, the charges being at a maximum when the current is zero, and the current at a maximum when the charges have, for the moment, disappeared. Outside the rod we have a similar set of charges, lines of electric strain stretching from end to end of the rod, alternating with rings of magnetic flux embracing the rod (see Fig. 5). So far, we have supposed the oscillation to be relatively a slow one.

FIG. 5.

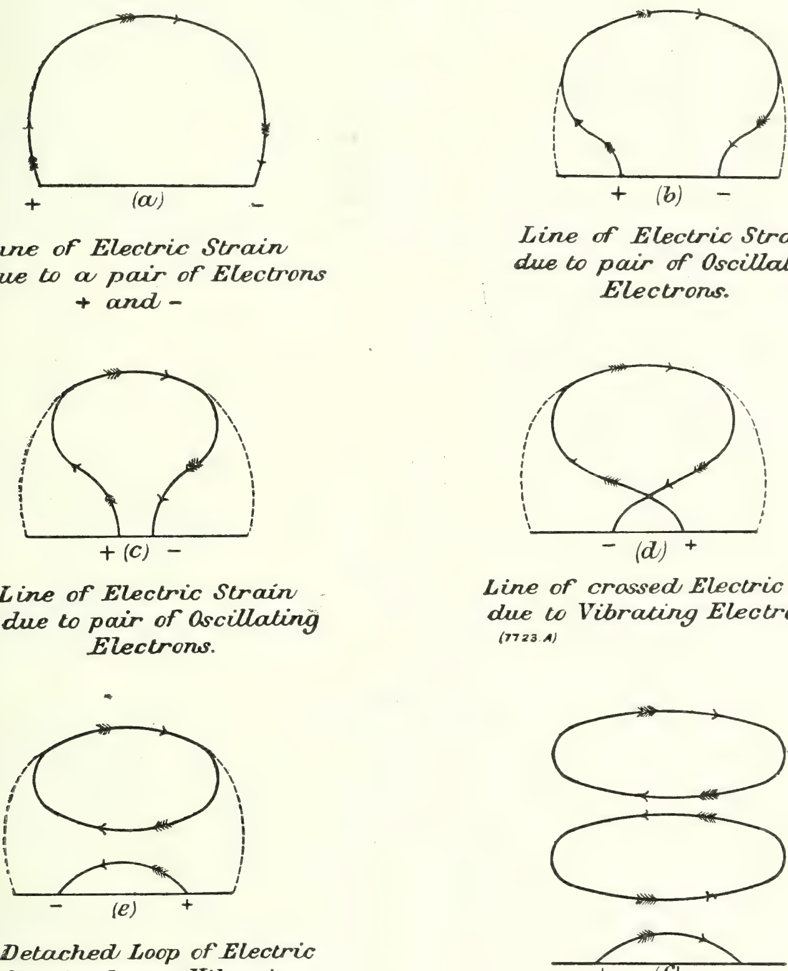


Rings of Magnetic Flux round Linear Oscillator.

Imagine next that the to-and-fro movement of the electrons or charges is sufficiently rapid to bring into play the inertia quality of the medium. We then have a different state of affairs. The lines of strain in the external medium cannot contract or collapse quickly enough to keep up with the course of events, or movements of the electrons in the rod, and hence their regular contraction and absorption is changed into a process of a different kind. As the electrons and co-electrons, that is, the electric charges, vibrate to and fro, the lines of electric strain are nipped in and thrown off as completely independent and closed lines of electric strain, and at each successive alternation, groups or batches of these loops are thrown off from the rod and, so to speak, take on an independent existence. The whole process of the formation of these self-closed lines of electric strain is best understood by examining a series of diagrams which roughly represent the various stages of the process. In Fig. 6 we have a diagram (a) the curved line in which delineates approximately the form of one line of electric strain round a linear oscillator, with spark gap in the centre, one half being charged positively and the other negatively.

Let us then suppose that the insulation of the spark gap breaks down, the opposite electric charges rush together and oscillate to and fro. The strain lines at each oscillation are then crossed or decussate, and the result, as shown in Fig. 6 (*d*), is that a portion of the energy of the field is thrown off in the form of self-closed lines of strain. See Fig. 6 (*e*). At each oscillation of the charges, the direction of the lines of strain springing from end to end of the radiator is reversed. It is a general property of lines of strain, whether electric or magnetic, that there is a tension along the line, and a pressure at right angles. In other words, these lines of electric strain are like elastic threads, they tend to contract the direction of their length, and they press sideways on each other when in the same direction. Hence it is not difficult to see that as each batch of self-closed lines of strain are thrown off, the direction of the strain round each loop being alternately in one direction and in the other, these loops of electric strain must press each other outwards, and each one that is formed squeezes the already formed loops farther and farther from the radiator. The loops therefore march away into space (see Fig. 6), *f*. If we imagine ourselves standing at a little distance at a point on the equatorial line, and able to see these loops of strain as they pass, we should recognise a procession of loops consisting of alternately directed strain lines marching past.

Fig. 6.



Line of Electric Strain due to a pair of Electrons + and −

Line of Electric Strain due to pair of Oscillating Electrons.

Line of Electric Strain due to pair of Oscillating Electrons.

Line of crossed Electric Strain due to Vibrating Electrons.

Detached Loop of Electric Strain due to Vibrating Electrons.

Two detached Loops of Electric Strain.

Hence along a line drawn perpendicular to the radiator, through its centre, there is a distribution of electric strain normal to that line, which is periodic in space and in time. Moreover, in addition to these lines of electric strain there are at right angles to them, another set of self-closed lines of magnetic flux. Alternated between the instants when the electric charges at the ends of the radiator are at their maximum, we have instants when the radiator rod is the seat of an electric current, and hence the field round it is filled with circular lines of magnetic flux coaxial with the radiator. As the current alternates in direction, each half period, these rings of magnetic flux alternate in direction as regards the flux, and hence we must complete our mental picture of the space round the radiator rods when the charges are oscillating, by supposing it filled with concentric rings of magnetic flux which are periodically reversed in direction, and have their maximum values at those instants and places where the lines of electric strain have their zero values. Accordingly, along the equatorial line we have two sets of strains in the aether, distributed periodically in space and in time. First, the lines of electric strain in the plane of the radiator, and secondly, the lines of magnetic flux at right angles to these. At any one point in space these two changes, the strain and the flux, succeed each other periodically, being however at right angles in direction. At any one moment, these two vectors are distributed periodically or cyclically through space, and these changes in time and space constitute an *electrical wave* or electromagnetic wave.

The following facts can be proved either experimentally or mathematically :—

(1) These lines of electric strain and magnetic flux which are thrown off from the radiator rods, travel out into space with the velocity of light.

(2) The wave length, or shortest distance from one place of maximum to another, whether strain or flux, is just twice the total length of the radiator rods.

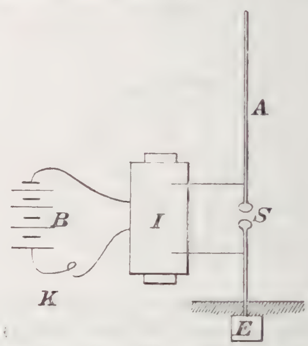
(3) The energy contained in any volume of the medium due to the strain and flux in it, is half electric and half magnetic at places not too near the rods.

(4) The electro-magnetic waves, so generated by the electrical oscillations in the rods, have all the properties of wave motion in general, and can be reflected, refracted, absorbed, and collected.

(5) Energy is transferred through space in a direction perpendicular to the plane containing the lines of electric strain and magnetic flux.

We may next proceed to apply these principles to the explanation of the action of the simplest form of Hertzian wave telegraphic radiator, viz., the early form of Marconi aerial wire. In its original form, this consists of a long vertical insulated wire A, the lower end of which is attached to one of the spark balls of an induction coil I, the other spark ball being connected to earth E, and the two spark balls being placed a few millimeters apart (see Fig. 7). When the coil is set in action, oscillatory or Hertzian sparks pass between the balls, and electric oscillations are set up in the wire, and electric waves are

Fig. 7.



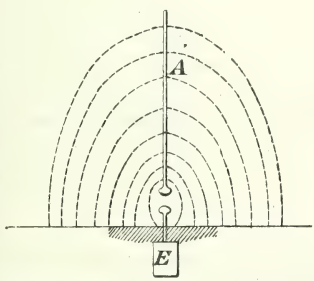
Simple Marconi Aerial Radiator.

radiated from it. Deferring until the next lecture a more detailed examination of the operations of the coil and at the spark gap, we may here say that the action which takes place in the aerial wire is as follows :—The wire is first charged to a high potential, let us suppose with negative electricity. We may imagine this process to consist in forcing additional electrons into it, the induction coil acting as an electron pump. Up to a certain pressure the spark gap is a perfect insulator, but at a critical electric pressure, which for spark gap lengths of four or five millimeters, and balls about one centimeter in diameter, approximates to three thousand volts per millimeter, the insulation of the air gives way, and the charge in the wire rushes into the earth. In consequence, however, of the inertia of the medium or of the electrons, the charge, so to speak, overshoots the mark, and the wire is then left with a charge of opposite sign. This, again, in turn rebounds, and so the wire is discharged by a series of electrical oscilla-

tions consisting of alternations of static charge and electric discharge. We may fasten our attention either on the events taking place in the vertical wire or in the medium outside, but the two sets of phenomena are inseparably connected, and go on together. When the aerial wire is statically charged, we may describe it by saying that there is an accumulation of electrons or co-electrons in it. Outside the wire there is, however, a distribution of electric strain, the strain lines proceeding from the wire to the earth (see Fig. 8).

The wire has *capacity* with respect to the earth, and it acts like the inner coating of a Leyden jar, of which the dielectric is the air and æther around it, and the outer coating is the earth's surface. When the discharge takes place, we may consider that electrons

FIG. 8.



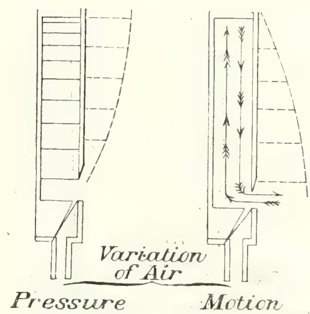
Lines of Electric Strain round Marconi Aerial before discharge.

rush out of the wire, and then that co-electrons rush back again into it. At the moment when the electron rush out of or into the aerial is taking place, we say there is an electric current flowing into or out of the wire, and this electron movement, therefore, creates the magnetic flux which is distributed in concentric circles round the wire. This current can be proved to exist by its heating effect upon a fine wire inserted in series with the aerial, and in the case of large aerials, it may have a mean value of many amperes, and a maximum value of hundreds of amperes. Inside the aerial wire we have, therefore, alternations of electrical potential or charge, and electric current, or we may call it electron pressure, and electron movement.

There is, therefore, an oscillation of electrons in the aerial wire, just as in the case of an organ pipe there is an oscillation of air molecules in the pipe. Outside the aerial we have variations and distributions of electric stain and magnetic flux. The resemblance between the closed organ pipe and the simple Marconi aerial is, in fact, very complete. In the case of the closed organ pipe, we have a longitudinal oscillation of air molecules in the pipe. At the open end or mouthpiece, where we have air moving in and out, the air movement is alternating and considerable, but there is little or no variation of air pressure. At the upper or closed end of the pipe we have great variation of air pressure, but little or no air movement (see Fig. 9).

Compare this now, with the electrical phenomena of the aerial. At the spark ball, or lower end, we have little or no variation of potential or electron-pressure, but we have electrons rushing into and out of the aerial at each half oscillation, forming the electric discharge or current. At the upper or insulated end, we

FIG. 9.



CLOSED ORGAN PIPE.

have little or no current, but great variation of potential or electron pressure. Supposing we could examine the wire inch by inch, all the way up from the spark balls at the bottom to the top, we should find at each stage of our journey that the range of variation and maximum value of the current in the wire became less and those of the potential became greater. At the bottom end we have nearly zero potential, or no electric pressure, but large current, and at the top end no current, but great variation of potential.

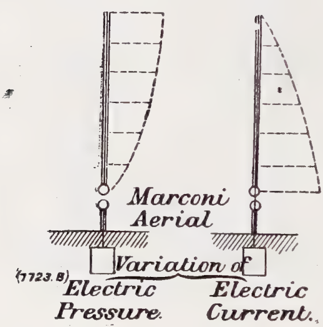
We can represent the amplitude of the current and potential values along the aerial by the ordinates of a dotted line so drawn that its distance from the aerial represents the potential oscillation or current oscillation at that point (see Fig. 10, p. 718).

This distribution of potential and current along the wire does not necessarily imply that any one electron moves far from its normal position. The actual movement of any particular molecule in the case of a sound wave, is

probably very small, and reckoned in millionths of a millimeter. So we must suppose that any one individual electron may have a small individual amplitude of movement, but the displacement is transferred from one to another. Conduction in a solid may be effected by the movement of free electrons intermingled with the chemical atoms, but any one electron may be continually passing from a condition of freedom to one of combination.

So much for the events inside the wire, but now outside the wire its electric charge is represented by lines of electric strain springing from the aerial to the earth. It must be remembered that every line of strain which is not endless must terminate on an electron and a co-electron. Hence when the discharge or spark takes place between the spark balls, the rapid movement of the electrons in the wire is accompanied by

FIG. 10.



a redistribution and movement of the lines of strain outside. As the negative charge flows out of the aerial, the ends of the strain lines abutting on to it run down the wire, and are transferred to the earth, and at the next instant, this semiloop of electric or æther strain with its ends on the earth, is pushed out sideways from the wire by the growth of a new set of lines of æther strain lines in an opposite direction. The process is best understood by consulting a series of diagrams which represent the distribution and approximate form of one strain line at successive instants (see Fig. 11, p. 719). In between the times of formation of the successive strain lines between the aerial and the earth, corresponding to the successive alternate electric charges of the aerial with opposite sign, there are a set of concentric rings of magnetic flux formed round it which are alternately in opposite directions, and these expand out, keeping step with the progress of the detached strain loops, and having their planes at right angles to the latter. As the semi-loops of electric strain march outward with their feet on the ground, these strain lines must always be supposed to terminate on electrons, but not continually on the same electrons. Since the earth is a conductor, we must suppose that there is a continual migration of the electrons forming the atoms of the earth, and that when one electron enters an atom, another leaves it. Hence corresponding to the electric wave in the space above, there are electrical changes in the ground beneath. This view is confirmed by the well-known fact that the achievement of Hertzian wave telegraphy is much dependent on the nature of the surface over which it is conducted, and can be carried on more easily over good conducting material like sea water, than over badly conducting dry land.*

The matter may be viewed, however, from another standpoint. Good conductors are opaque to Hertzian waves; in other words, are non-absorptive. The energy of the electric wave is not so rapidly absorbed when it glides over a sea surface, as when it is passing over a surface which is an indifferent conductor, like dry land. In fact, it is possible, by the improvement of the signals, to detect a heavy fall of rain in the space between two stations separated only by dry land.†

It is, however, clear, that on the electronic theory, the progression of the lines of electric strain can only take place if the surface over which they move is a fairly good conductor, unless these lines of strain form completely closed loops.

Hence we may sum up by saying that there are three sets of phenomena to which we must pay attention in formulating any complete theory of the aerial. The first is the operation taking place in the vertical wire, which is described by saying that electrical oscillations or vibratory movements of electrons are taking place in it, and on our adopted theory, it may be said to consist in a longitudinal

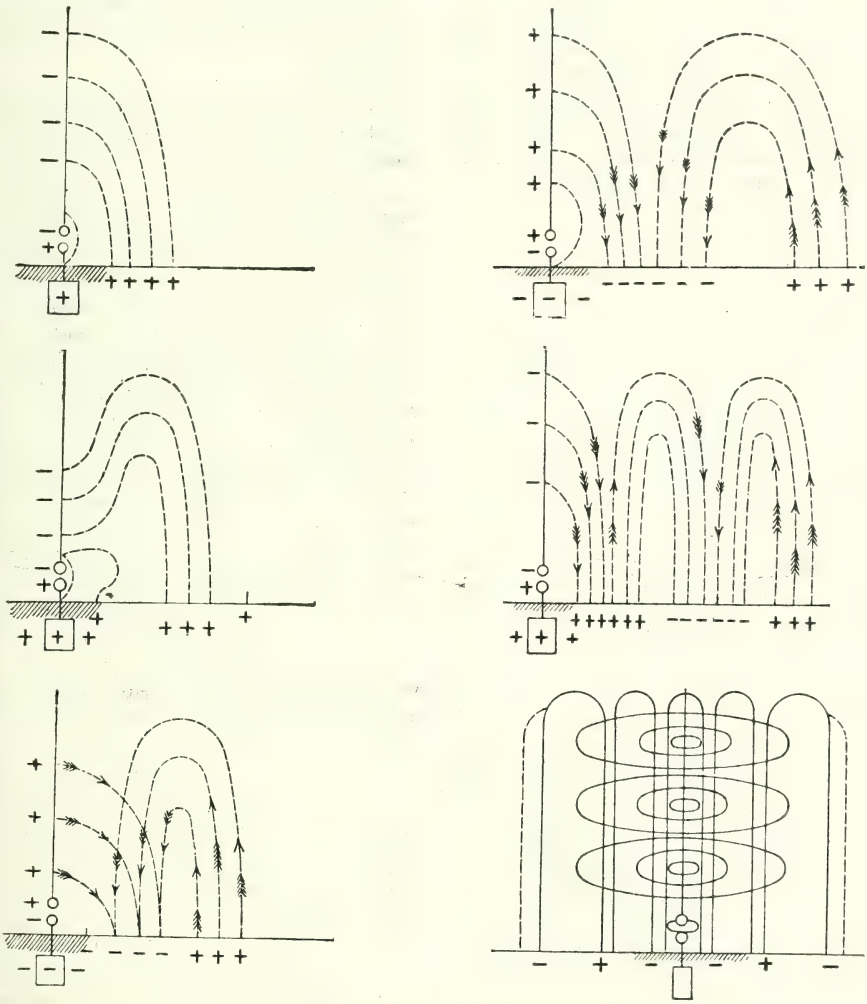
* At the time when Mr. Marconi's work first began to attract public attention, many theories were put forward to explain the action of his vertical air wire or aerial, some of them unquestionably very unsound. Two articles, however, appeared in the *Electrical Review* of May 12th and 19th, 1899, by Mr. J. E. Taylor, entitled "Electrical Radiation," which gave a correct view of the principal actions at work, and of the application of Hertz's ideas to the matter in question. The detachment of loops of electric strain from the aerial was quite clearly explained.

† This important matter is more fully dealt with in a subsequent lecture of this series, in considering the influence of locality of stations in Hertzian wave telegraphy.

vibration of electrons of such a nature that we may appropriately call the aerial an æther organ pipe. Then, in the next place, we have the distribution and movement of the lines of strain and magnetic flux in the space outside the wire, constituting the electric wave, and lastly, there are the electrical changes in the conductor over which the wave travels, which is the earth or water surrounding the aerial. In dealing with the details of transmitting arrangements in the next lecture, attention will be directed to the necessity for what telegraphists call "a good earth" in connection with Hertzian wave telegraphy. This only means that there must be a perfectly free egress and ingress for the electrons leaving or entering the aerial, so that nothing hinders their access to the conducting surface over which the wave travels. There must be nothing to stop or throttle the rush of electrons into or out of the aerial wire, or else the lines of strain cannot be detached and travel away.

We may next consider more particularly the energy which is available for radiation, and which is radiated. In the original form of simple Marconi aerial, the aerial itself, when insulated, forms one coating or surface of a condenser, the dielectric being the air and æther around it, and the other conductor being the earth. The electric energy stored up in it, just before discharge takes place, is numerically equal to the product of the capacity of the aerial, and half the square of the potential to which it is charged.

Fig. 11.



If we call C. the capacity of the aerial in microfarads, and V. the potential in volts, to which it is raised before discharge, then the energy storage in joules (E.) is given by the equation $E = \frac{1}{2} C V^2/10^6$. Since one joule is nearly equal to three-quarters of a foot-pound, the energy storage in foot-pounds (F) is roughly given by the rule

$$F = \tfrac{3}{8} C V^2/10^6.$$

For spark lengths of the order of five to fifteen millimeters, the disruptive voltage in air of ordinary pressure is at the rate of 3,000 volts per millimeter. Hence if S stands for the spark length in millimeters, and C for the aerial capacity in microfarads, it is easy to see that the energy storage in foot-pounds is:

$$F = \frac{27 C S^2}{8}$$

If the aerial consists of a stranded wire formed of $^7/_{22}$, and has a length of 150 feet, and is insulated and held vertically, with its lower end near the earth, it would have a capacity of about one three ten-thousandths of a microfarad or 0·0003 microfarad. Hence if it is used as a Marconi aerial, and operated with a spark gap of one centimeter in length, the energy stored up in the wire before each discharge, would be only one-tenth (0·1) of a foot-pound.

By no means can all of this energy be radiated as Hertz waves, part of it is dissipated as heat and light in the spark, and yet such an aerial can, with a sensitive receiver such as that devised by Mr. Marconi, make itself felt for a hundred miles over sea in every direction. This fact gives us a first glimpse of the extremely small energy which, when properly imparted to the æther, can effect wireless telegraphy over immense distances. Of course, the minimum telegraphic signal, say the Morse dot, may involve a good many, perhaps half a dozen discharges of the wire, but even then the amount of energy concerned in affecting the receiver at the distant place is exceedingly small.

The problem, therefore, of long distance telegraphy by Hertzian waves is largely, though not entirely, a matter of associating sufficient energy with the radiator. There are, obviously, two things which may be done, first, we may increase the capacity of the aerial, and secondly, we may increase the voltage of the discharge, or, in other words, lengthen the spark gap. There is, however, a well defined limit to this last achievement. If we lengthen the spark gap too much, the resistance becomes too great, and the spark ceases to be oscillatory. We can make a discharge, but we obtain no radiation. When using a ten-inch induction coil, about a centimeter, or, at most, a centimeter or two, is the limiting length of oscillatory sparks; in other words, our available potential difference is restricted to 30,000 or 40,000 volts. By other appliances, we can, however, obtain oscillatory sparks having a voltage of 100,000 or 200,000 volts, and so obtain what Hertz called "active sparks," five or ten centimeters in length.

Turning, then, to the question of capacity, we may enquire in the next place how the capacity of an aerial wire can be increased. This has generally been done by putting up two or more aerial wires in contiguity, and joining them together, and so making arrangements called, in the admitted slang of the subject, "multiple aerials." The measurement of the capacity of insulated wires can be easily carried out by means of an appliance devised by the author and Mr. W. C. Clinton, consisting of a rotating commutator which alternately charges the insulated wire at a source of electromotive force, and then discharges it through a galvanometer. If this galvanometer is subsequently standardised, so that the ampere value of its deflection is known, we can determine easily the capacity C of the aerial or insulated conductor, reckoned in microfarads, when it is charged to a potential of V volts, and discharged n times a second through a galvanometer. The series of discharges are equivalent to a current of which the value in amperes A is given by the equation:

$$A = \frac{n V C}{10^6}$$

and hence if the value of the current resulting is known, we have the capacity of the aerial or conductor, expressed in microfarads, given by the formula:

$$C = \frac{A\ 10^6}{n V}$$

A series of experiments made on this plan have revealed the fact that if a number of vertical insulated wires are hung up in the air, and rather near together, the electrical capacity of the whole of the wires in parallel is not nearly equal to the sum of their individual capacities. If a number of parallel insulated wires are separated by a distance equal to about 3 per cent. of their length, the capacity of the whole lot together varies roughly as the square root of their number. Thus, if we call the capacity of one vertical

wire in free space unity, then the capacity of four wires placed rather near together, will only be about twice that of one wire, and that of twenty-five wires will only be about five times one wire.

This approximate rule has been confirmed by experiments made with long wires, 100 to 200 feet in length, in the open air. Hence, it points to the fact, that the ordinary plan of endeavouring to obtain a large capacity by putting several wires in parallel, and not very far apart, is very uneconomical in material. The diagrams in Fig. 12 show the various methods which have been employed by Mr. Marconi and others, in the construction of such multiple wire aerials. If, for instance, we put four insulated stranded $7/_{22}$ wires, each 100 feet long, about six feet apart, all being held in a vertical position, the capacity of the four together is not much more than twice that of a single wire. In the same manner, if we arrange 150 similar wires, each 100 feet long, in the form of a conical aerial, the wires being distributed at the top round a circle 100 feet in diameter, the whole group will not have much more than twelve times the capacity of one single wire, although it weighs 150 times as much.

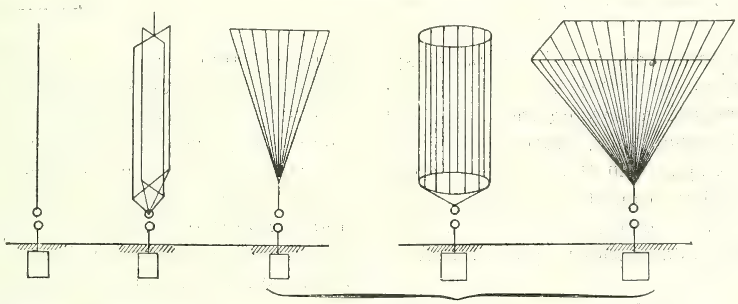
The author has designed an aerial (see Fig. 13, p. 722), in which the wires, all of equal length, are arranged sufficiently far apart not to reduce each other's capacity.

As a rough guide in practice, it can be borne in mind that a wire about one-tenth of an inch in diameter, and one hundred feet long, held vertical and insulated with its bottom end about six feet from the ground, has a capacity of 0·002 of a microfarad, if no other earthed vertical conductors are very near it. The moral of all this is that the amount of electric energy which can be stored up in a simple Marconi aerial, is very limited, and is not more than one-tenth of a joule, or one-fourteenth of a foot-pound, per hundred feet of $7/_{22}$ wire. The astonishing thing is, that with so little storage of energy, it should be possible to transmit intelligence to a distance of a hundred miles, without connecting wires.

One consequence, however, of the small amount of energy which can be accumulated in a simple Marconi aerial, is that this energy is almost entirely radiated in one oscillation or wave. Hence, strictly speaking, a simple aerial of this type does not create a train of waves in the æther, but probably at most a single impulse or two.

We shall, in a later lecture, consider some consequences which follow from this fact. Meanwhile, it may be explained that there are methods by which not only a much larger amount of energy can be accumulated in connection with an 'aerial,' and more sustained oscillations created, than by the original Marconi method. One of these methods appears to have originated with Professor Braun of Strasburg, and an important improvement on it, without which addition the original suggestion is not very useful, was first described by Mr. Marconi, in a lecture in this room.* In this arrangement, the charge in the aerial is not created by the direct application to it of the secondary terminal of an induction coil, but by means of an induced electromotive force created in the aerial by an oscillation transformer. A condenser or Leyden jar has one terminal, say its inside, connected to one spark ball of an induction coil. The other spark ball is connected to the outside of the Leyden jar or condenser, through the primary coil of an air core transformer of a particular kind, called

FIG. 12.—MARCONI AERIALS.

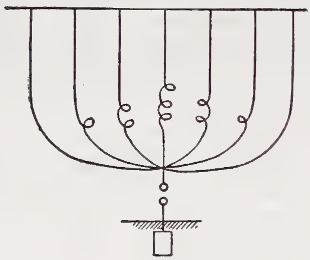


Simple. *Quadruple.* *Multiple.*

* G. Marconi, "Syntonic Wireless Telegraphy." *Journal of the Society of Arts*, vol. 49, p. 501, 1901.

an oscillation transformer (see Fig. 14). The spark balls are brought within a few millimeters of each other. When the coil is set in operation, the jar is charged and discharged through the spark gap, and electrical oscillations are set up in the circuit consisting of the dielectric of the jar, the primary coil of

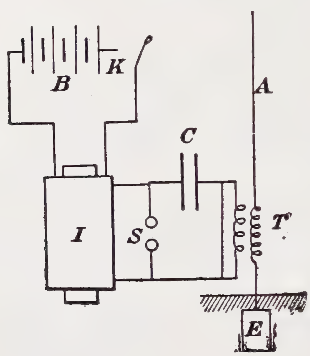
FIG. 13.



Equi-Periodic Aerials.
All wires same length widespaced.

the oscillation transformer, and the spark gap. The secondary circuit of this oscillation transformer is connected in between the earth, and the insulated aerial wire, hence when the oscillations take place in the primary circuit, they induce other oscillations in the aerial circuit. But the arrangement is not very effective unless, as first shown by Mr. Marconi,

FIG. 14.

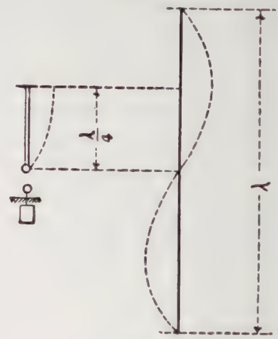


MARCONI-BRAUN RADIATOR.

the two circuits of the oscillation transformer are tuned together.

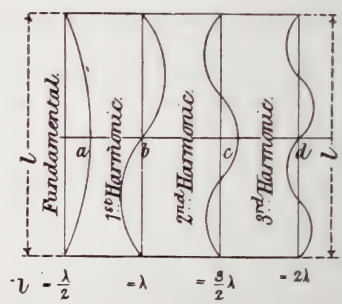
We shall return to the consideration of this form of transmitter in the second lecture; meanwhile, we may notice that, by means of such an arrangement, it is possible to create in the aerial a far greater charging electromotive force than would be the case if the aerial were connected directly to one terminal of the secondary circuit of the induction coil, the other terminal being to earth, and the two terminals connected as usual by spark balls. By the inductive arrangement it is possible to create in an aerial, electromotive forces which are equivalent to a spark of a foot in length, and, when the length of the aerial is also

FIG. 15.



properly proportioned, the potential along it will increase all the way up, until, at the top or insulated end of the aerial, it may reach an amount capable of giving sparks several feet in length. From the remarks already made on the analogy between the closed organ pipe and the Marconi aerial, you will at once see that the wave which is radiated from the aerial must have a wave length four times that of the

FIG. 16.



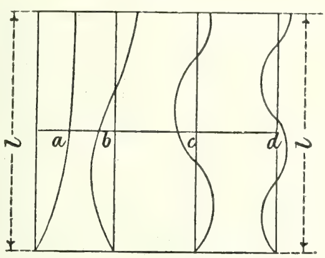
HARMONICS OF OPEN ORGAN PIPE.

aerial if the aerial is vibrating in its fundamental manner (see Fig. 15). It is also possible to create electrical oscillations in a vertical wire which are the harmonics of the fundamental.

You are all probably aware, that in the case of an organ pipe, if the pipe is blown gently it sounds a note which is called the fundamental of the pipe. The celebrated mathematician, Daniel Bernouilli, discovered that an organ

pipe can be made to yield a succession of musical notes by properly varying the pressure of the current of air blown into it. If the pipe is an open pipe, and if we call the frequency of the primary note obtained when the pipe is gently blown, unity, then when we blow more strongly, the pipe yields notes which are the harmonics of the fundamental one ; that is to say, notes which have frequencies represented by the numbers 2, 3, 4, 5, &c. (see Fig. 16). If, however, the pipe is closed at the top, then over-blowing the pipe makes it yield the odd harmonics, or the tones which are related to the primary tone in the ratio of 3, 5, 7, &c. to unity (see Fig. 17). Accordingly, if a stopped pipe gives as its fundamental the note C, its first overtone will be the fifth above the octave, or G. It will be seen, therefore, that the aerial may be looked upon as a kind of æther

FIG. 17.

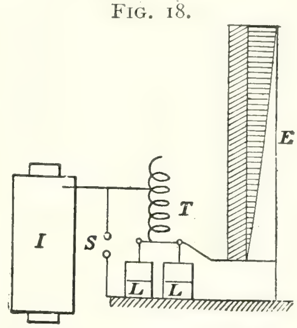


$l = \frac{\lambda}{4} \quad = \frac{3\lambda}{4} \quad = \frac{5\lambda}{4} \quad = \frac{7\lambda}{4}$

HARMONICS OF CLOSED ORGAN PIPE.

organ pipe, and its electrical phenomena are in every respect similar to the acoustic phenomena of the ordinary closed organ pipe. When the aerial is sounding its fundamental æther note, the conditions which pertain are that there is a current flowing into the aerial at the lower end, but at that point the variation in potential is very small, whereas at the upper end there is no current, but the variations of potential are very large. Accordingly, we say that at the upper end of the aerial there is an antinode of potential and a node of current, and, at the bottom, an antinode of current and a node of potential. By altering the frequency of the electric impulses, we can create in the aerial an arrangement of nodes of current or potential corresponding to the overtones of a closed organ pipe (see Fig. 17). But whatever may be the arrangement, the conditions must always hold that there is a node of current at the upper end and an antinode of current at the lower end. In other words, there are large variations of current at the place where the aerial terminates on the spark gap, and no current at the upper end. The first harmonic is formed when there is a node of potential at one-third of the length of the aerial from the top, and under these circumstances, we may represent the amplitude of vibrations of potential in the wire by the diagram (*b*) in Fig. 17, where the distance of the curved line from the straight line, representing the aerial, represents the amplitude of potential variation at that point. In this case, we have a node of potential not only at the lower end of the wire, but at two-thirds of the way up. In the same way, we can create in the closed organ pipe, by properly overblowing the pipe, a region about two-thirds of the way up the pipe, where the pressure changes in the air are practically no greater than they are at the mouthpiece. I can make evident to you

FIG. 18.

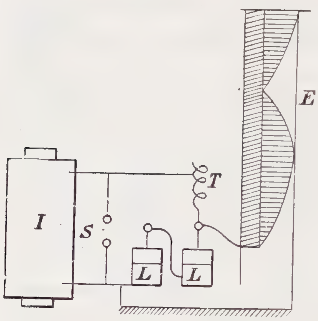


SEIBT'S RESONATOR TUNED TO FUNDAMENTAL.

visually in a beautiful manner the existence of these electrical nodes in an aerial, by means of an ingenious arrangement, which has been devised by Dr. Georg Seibt, of Berlin. It consists of a very long silk-covered copper wire wound in a spiral of single layer round a wooden rod, six feet long, and about two inches in diameter. This rod is insulated, and at the lower end the wire is connected to a Leyden jar circuit, consisting of a Leyden jar or jars, and an inductance coil, the inductance of which can be varied. Oscillations are set up in this jar circuit by means of an induction coil discharge, and the lower end of the long spiral wire is attached to one point on the jar circuit. In this manner, I communicate to the bottom end of the long spiral wire a series of electric impulses, the time period of which depend upon the capacity of the jar, and the inductance of the discharge circuit. I have the power to vary this frequency over wide limits. Parallel to the long spiral wire is suspended another copper wire (see Fig. 18), and between this wire and

the silk-covered copper wire discharges take place due to the potential difference existing between each part of the wire and this long aerial wire. If now I arrange matters so that the impulses communicated to the bottom end of the long spiral wire correspond to its fundamental note or periodic time, and if we darken the room, you will see a luminous appearance in between the vertical wire and the spiral wire, which increases in intensity all the way up to the top of the spiral wire. The luminosity of this brush discharge at any point is evidence of the potential of the spiral wire at that point, but as you can see, it clearly demonstrates that the difference of potential between the spiral wire and the earth wire increases all the way up from the bottom to the top of the spiral wire. In the next place, by making a little

FIG. 19.



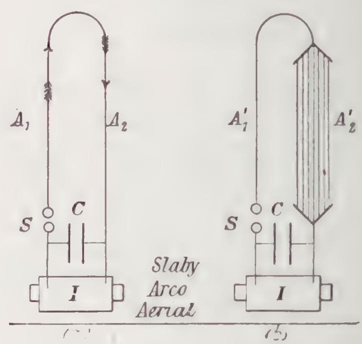
SEIBT'S RESONATOR TUNED TO FIRST OVERTONE.

adjustment and by varying the inductance of the jar circuit, I can increase the frequency of the impulses which are falling upon the spiral wire, and then you will notice that the distribution of the brush discharge or luminosity is altered, and that there is a maximum now at about one-third of the height of the spiral wire, and a dark place at about two-thirds of the height, and another bright place at the top, thus showing that we have a node of potential at about two-thirds the way up the wire (see Fig. 19), and we have therefore set up in the spiral wire electrical oscillations corresponding to the first overtone. It is possible to show in the same way the existence of the second harmonic in the coil, but the luminosity then becomes too faint to be seen at a distance, and exhibited as a lecture experiment.

There is one interesting form of aerial, which has been devised by Professor Slaby, of Berlin, which depends for its action entirely on the fact that the electrical oscillations set up in it which radiate, are harmonics of the fundamental tone.

A closed vertical loop A_1 A_2 (see Fig. 20 *a*) is formed by erecting two parallel insulated wires vertically, a few feet apart, and joining them together at the top. If at the bottom these wires are connected, one with the secondary terminals of an induction coil, and condenser (C) or Leyden jar bridged across the terminals, and a pair of spark balls (S) inserted on one side of the loop, then you will readily see, that on setting the coil in action oscillations will take place in these vertical wires, but that if the oscillations are simply the fundamental note of the system, then at any moment corresponding to a current going up one side of the loop of wire, there must be a current coming down on the other. Accordingly, an

FIG. 20.

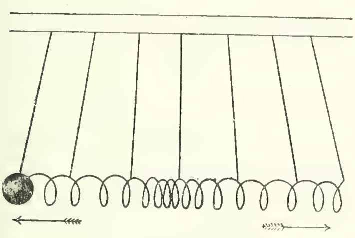


arrangement of this kind, forming what is called a closed circuit, will not radiate, or radiates but very feebly. Professor Slaby found, however, that it might be converted into a powerful radiator if we give the two sides of the loop unequal capacity or inductance, and at the same time earth one of the lower ends of the loop, as shown in Fig. 20 (*b*). By this means, it is possible to set up in the loop electrical overtones or harmonics of the fundamental oscillation, and if we cause the system to vibrate so as to produce its first odd harmonic, there is a potential node at the lower end of both vertical sides of the loop, a potential node on both vertical sides at two-thirds of the way up, and a potential antinode at the summit of the loop, then, under these circumstances, the closed loop of wire is in the same electrical condition as if two simple Marconi aerials, both emitting their first odd harmonic oscillation, were placed side by side and joined together at the top.

It is a little difficult, without the employment

of mathematical analysis, to explain precisely the manner in which earthing one side of the loop, or making the loop unsymmetrical as regards inductance, has the effect of creating overtones in it. The following rough illustration may, however, be of some assistance. Imagine a long spiral metallic spring, supported horizontally by threads (see Fig. 21). Let this represent a conductor, and let any movement to or fro of a part of the spring represent a current in that conductor. Suppose we take hold of the spring at one end, we can move it bodily to and fro as a whole. In this case, every part of the spring is moving one way or the other in the same manner at the same time. This corresponds with the case in which the discharge of the condenser, through the uniform loop conductor, is a flow of electricity all in one direction one way or the other. The current is in the same direction in all parts

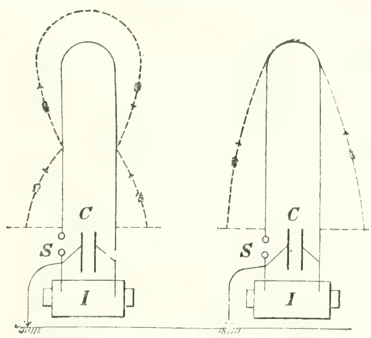
FIG. 21.



of the loop at the same time, and, therefore, if the current is going up one side of the loop, it is at the same time coming down the other side. Hence the two sides of the loop are always in exact opposition as regards the effect of the current in them on the external space, and the loop does not radiate. Returning again to the case of the spring: supposing that we add a weight to one end of the spring by attaching to it a metal ball (see Fig. 21), and we then move the other end to and fro with certain periodic motion, it will be found quite easy to set up in the spring a pulsatory motion resembling the movement of the air in an open organ pipe. In this case, both ends of the spring are moving inwards or outwards at the same time, and the central portions of the spring, although being pressed and expanded slightly, are moving to and fro very little. In the case of the looped aerial, this corresponds with a current flowing up or down both sides at the same time; in other words, when this mode of electrical oscillation is established in the loop, its electrical condition is just that of two simple Marconi aerials joined together at the top, and vibrating in their fundamental manner. Accordingly, if one side of the double loop is earthed, we then have an arrangement which radiates waves. Professor Slaby found that, by giving one side of the loop less inductance than the other, and at the same time earthing the side having greater inductance at the bottom (see Fig. 22), that he was able to make an arrangement which radiated not in virtue of the normal oscillations of the condenser, but in virtue of the harmonic oscillations set up in the conductor itself. The mathematical theory of this radiator has been very fully developed by Dr. George Seibt.

It will be seen, therefore, that there are several ways in which we may start into existence oscillations in an aerial. First, the

FIG. 22.

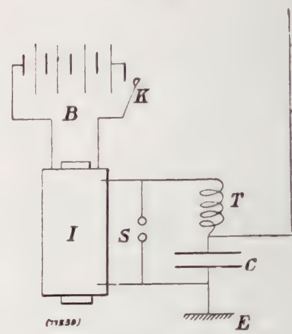


aerial may be insulated, and we may charge it to a high potential and allow this charge to suddenly rush out. Although this process gives rise to a disturbance in the æther, as already explained, it is analogous to a pop or explosion in the air rather than to a sustained musical note. The exact acoustic analogue would be obtained if we imagine a long pipe pumped full of air and then suddenly opened at one end. The air would rush out, and, communicating a blow to the outer air, would create an atmospheric disturbance appreciated as a noise or small explosion. This is what happens when we cut the string and let the cork fly out from a bottle of champagne. At the same time the inertia of the air rushing out of the tube would cause it to overshoot the mark, and a short time after opening the valve the tube, so far from containing compressed air, would contain air slightly rarefied near its mouth, and this rarefaction would travel back up the tube in the form of wave motion, and, being reflected as condensation at the closed end, travel down again, and so, after being

reflected one or twice at the open or closed end, become damped out rapidly in virtue of both air friction and the radiation of the energy. In the case, however, of the ordinary organ pipe, we do not depend upon a store of compressed air put into the pipe, but we have a store of energy to draw upon in the form of the large amount of compressed air contained in the wind chest, which is being continually supplied by the bellows. This store of compressed air is fed into the organ pipe, with the result that we obtain a continuous radiation of sound waves. The first case in which the only store of energy is the compressed air originally contained in the pipe, illustrates the operation of the simple Marconi aerial. The second case, in which there is a larger store of energy to draw upon, the organ pipe being connected to a wind chest, illustrates the method in which an aerial is employed to radiate a store of electric energy contained in a condenser, gradually liberated by the aerial in the form of a series of electrical oscillations and waves. In this arrangement, the condenser corresponds to the wind chest, and it is intermittently charged with electricity by means of the induction coil or transformer, which answers to the bellows of the organ. From the condenser, electrical energy is discharged each time the spark discharge passes at the spark gap in the form of electrical oscillations in the transformer. The secondary circuit of this transformer is connected in between the earth and the aerial, and therefore may be considered as part of it, and accordingly, the energy which is radiated from the aerial is not simply that which is stored up in it, in virtue of its own small capacity, but that which is stored up in the much larger capacity represented by the primary condenser, or as it may be called, the electrical wind chest. By the second arrangement, we have therefore the means of radiating more or less continuous trains of electric waves corresponding with each spark discharge.

To create powerful oscillations in the aerial, one condition of success is that there shall be an identity in time-period between the circuit of the aerial and that of the primary condenser. The aerial is an open circuit which has capacity with respect to the earth, and it has also inductance partly due to the wire of the aerial, and partly due to the secondary circuit of the oscillation transformer in series with it. The primary circuit or spark circuit has capacity, namely, the capacity of the energy-storing condenser, and it has also inductance, namely, the inductance of the primary circuit of the oscillation transformer. We shall consider in a later lecture, more particularly, other matters concerning this transmitter, but meanwhile, it may be said that one condition for setting up powerful waves, by means of the above arrangement, is that the electrical time-period of both the two circuits mentioned shall be the same. This involves adjusting the inductance and capacity so that the product of conductance and capacity for each of these two circuits is numerically the same. Instead of employing an oscillation transformer between the condenser circuit and the aerial, the aerial may be connected directly to some point on the condenser circuit at which the potential oscillations are large, and we have then the arrangement devised in one form by Professor Braun (see Fig. 23). In this case, in order to

FIG. 23.



BRAUN RADIATOR.

accumulate large potential oscillations at the top of the aerial, it is, as we have seen, necessary that the length of the aerial shall be one quarter the length of the wave.* If therefore the electrical oscillations in the condenser circuit are at the rate of N per second, in other words, have a frequency N, the wave length corresponding to this frequency is given by the expression :

$$3 \times 10^{10} / N \text{ cms.}$$

The number 3×10^{10} is the value in centimeters per second of the velocity of the electromagnetic wave, and is identical with that of light. The corresponding resonant length of

* In the course of his investigations on the discharge of a Leyden jar, Sir Oliver Lodge employed many years ago two long wires connected to the interior and exterior of a Leyden jar, adjusted as regards length to be equal to half a wave length of the discharge circuit of the jar, to show an experiment called the "recoil kick" of the wire. See *Phil. Mag.*, August, 1888, vol. 26, p. 227, or the *Electrician*, August 10, 1888, vol. 21, p. 435.

the aerial is, therefore, one-fourth of this wavelength, or $3 \times 10^{10}/4$ N. Generally speaking, however, it will be found that with any length of aerial which is practicable, say 200 feet, or 6,000 centimeters, this proportion necessitates rather a high frequency in the primary oscillation circuit. In the case considered, namely, for an aerial 200 feet in height, the oscillations in the primary circuit must have a frequency of one and a quarter million. This high frequency can only be obtained either by greatly reducing the inductance of the primary discharge circuit, or reducing the capacity. If we reduce the capacity, we thereby greatly reduce the storage of energy, and it is not practicable to reduce the inductance below a certain amount. Further details in connection with this arrangement as a transmitter, we shall consider in the next lecture.

Summing up, it may be said that there are three, and, as far as I am aware, at present only three, modes of exciting the electrical oscillations in an aerial. First, the aerial may itself be used as an electrical reservoir or condenser, and charged to a high potential and suddenly discharged to earth. This is the original Marconi method. The second method consists in attaching the aerial to some point on an oscillation circuit consisting of a condenser, an inductance, and a spark gap, in series with one another, and charging and discharging the condenser across the spark gap, so as to create alterations of potential at some point on the oscillation circuit. The length of the aerial must then be so proportioned as above described, so that it is resonant to this frequency. We may call such a resonant wire a quarter-wave-length wire, and it is an arrangement of this kind that we used just now, as devised by Dr. Seibt for lecture purposes. Thirdly, we may employ the arrangement involving an oscillation transformer, in which the oscillations in the primary condenser circuit are made to induce others in the aerial circuit, the time period of the two circuits being the same. This method may be called the Marconi-Braun method. Professor Slaby has combined together, in a certain way, the original Marconi simple aerial with the resonant quarter-wave-length wire of Braun. He constructs what he calls a *multiplicator*, which is really a wire wound into a loose spiral, connected at one point to an oscillation circuit, consisting of a condenser inductance, the length of this wire being proportioned so that there is a great resonance or multiplication of tension or potential at its free end. This free end is then attached to the lower end of an ordinary Marconi aerial, and serves to charge it with a higher potential than could be obtained by the use of the induction coil directly attached to it.

In the next lecture we shall follow up these devices, and study their application in the construction of transmitters for wireless telegraphy.

Miscellaneous.

NATURAL INDIGO.

The following particulars respecting indigo prospects are by the Calcutta correspondent of the *British Trade Journal*:—

A great deal has been written about indigo during the last few months, but the controversy can only tend to convey to the general public an erroneous idea. It has been contended that because the Maharajah of Darlangha turned his estates to the cultivation of *rhea*, that indigo-growing has been abandoned in East India; and because many consumers have adopted artificial indigo as an experiment to see how far it can replace the natural product, it is assumed that chemical indigo is the more advantageous of the two, and therefore preferred. The argument that the high price of indigo during the last Calcutta season again alienated many regular partisans and consumers of the natural product, causing them to continue adopting synthetic indigo, can be met in the following manner:—

In spite of the energetic and zealous work of the artificial indigo manufacturers, who have lost no opportunity of puffing their article, the world's consumption has taken up all the natural indigo produced, and the very heavy stocks which have always existed have never been so low as of late. If the Maharajah of Darlangha, as many other planters before him, has seen that, owing to the low prices prevailing, the land can be turned into better account in other ways, it shows nothing else but that in the comparatively small indigo district of lower Bengal the soil is not productive enough for this kind of culture, a fact which experts have known for years. Other districts continue to prosper satisfactorily, and will go on doing so if for the next few years better climatic conditions prevail than have existed with scarcely a break since 1898.

The rate of the Indian exchange has an important influence on the indigo trade. The 1895 to 1896 harvest which was an exceptionally good one, producing 160,000 maunds—about 40,000 cases, at an exchange of 1s. 1d. per rupee, yielded such high rupee prices that the planter was able to do a large business; in 1896 the exchange remained at 1s. 2d.; in 1897 it

went up to 1s. 3½d., and even at this high rupee price, and without raising the European value, it was found profitable to plant every inch of even the very poorest soil with indigo. Since 1898 we have had an almost stable exchange of 1s. 4½d., or, as compared with that of 1895 and 1896, 20 per cent. more unfavourable from the European buyer's point of view. It is therefore not to be wondered at if the estates less disposed to the production of indigo have been given over to other culture. It is quite clear to the producers in India that if they are to compete against artificial indigo they must supply a good quality of the natural product at a low price, and private individuals as well as the Indian Government are doing their utmost to introduce improvements in this direction, such as more careful tilling of the soil, a more rigorous choice in the selection of the seeds employed, and especially a better supervision of the process of fermentation. These are all more or less coming into use. The weather naturally exerts a great influence on the crop, and under the unfavourable conditions which have prevailed during the last few years, especially in 1902, it has been difficult to produce indigo at a profit at the present prices. In this connection it should be noted that up to the late autumn of last year "indigo" influenced the market value of all fast blues. There followed the decrease in price of the competitive chemical product in order to meet the reduced price of natual indigo, and although artificial indigo was cheap, it was never so low as it had been before the summer of 1902, owing to the bad crops of the natural product. This shows that the enhanced price not only caused no holding back in buying circles, but that already in the autumn of 1902 many of the stocks in Europe and the new supplies in India were sold on a rising market. The deliveries to all parts of the world indicate that the universal consumption did not kick against the higher prices; numerous orders remained unexecuted in Calcutta because the stock of about 43,000 maunds, or 10,800 cases, was not sufficient to satisfy the demand. Many American buyers, after trying both the artificial and the natural indigo, have gone back to the latter, and this shows that it not always the true blue dye-stuff which renders the best analysis which is the best in actual practice.

In dyeing circles it has been usual to inquire the analysis of indigo, *i.e.*, how much per cent. of indigotine it shows by the chameleon or permanganate process, and whoever, for the sake of convenience, only buys according to such analysis can easily be deceived. Every practical dyer knows that different lots of Bengal indigo, for example, which on analysis show, let us say, 60 per cent. of indigotine, produce a much higher percentage than this in the vats. But it has been found convenient, although it may not be rational, to base purchases on the analysed percentage, and not on the one which practical knowledge shows to exist. Natural indigo, therefore, by skilful manipulation would render a percentage of indigotine in excess of the analytical 60 per cent., whereas th artificial or synthetic product will give exactly th 60 per cent. and no more.

It is argued, on the other hand, that by buyin artificial indigo one knows exactly what streng one is getting, but the reply to this argument is th by purchasing the natural product a bonus is ob tained.

It is about eight years ago that alizarine blue (chemical indigo) was first presented to the dyein world as a superior substitute for natural indig and although it possesses good qualities of its ow it has not yet succeeded in rivalling it. Each of th two qualities holds its place in the textile industr an industry which from year to year demands eve increasing quantities of dye-stuffs, and time will sho for what particular uses each one is best adapte Up to the present cloths died with natural indig have withstood the effects of sea journeys and the sun's rays better than all others. It would not b in accordance with facts to assume that in the com petition between chemical and natural indigo a dec sion has as yet been reached in favour of or again one or other of the products.

In Indian planting circles the opinion is held th the question will only be solved when, under norm conditions, or at least more favourable weathe larger harvests with improved qualities are place upon the market, but this time is yet to come, and i the meantime it can safely be taken for granted th the natural as well as the chemical indigo will eac find its field of usefulness in the world's markets.

FRUIT GROWING IN BRITISH COLUMBIA

Conditions are said to be eminently favourable a through the interior of British Columbia for th production of apples of the finest quality and appear ance. There are certain valleys where wheat growin has been carried on, which are particularly well suite for apple growing, and a great portion of this area i to be used for the purpose, as the profits from appl growing are much greater than those obtained fro wheat growing when the business is intelligentl carried on. Small fruits grow everywhere. Prune do remarkably well in the Okanagan, and plums als The quality of prunes grown at Kelowna is superio to anything seen even in Oregon and Californi Certain varieties of pears do extremely well in th Okanagan country, the principal varieties bein "Bartlett," "Flemish," "Beauty," and "Winte Nellis." According to a recent report by the Britis Columbia Bureau of Provincial Information, frui growing commercially has really been on trial in th interior district, but it has now been definitely ascer tained that the conditions are all that could be desired and destructive insect pests, which militate so muc against the profits of fruit growing in the Eastern State and Provinces, are absent in British Columbia, con

sequently the expense of producing fine fruit is less. Tomatoes and melons also do well throughout the interior, and they are grown for market in Southern Okanagan. Peaches have been grown there for many years in small quantities, especially on the west side of Okanagan Lake, and large areas have been planted during the last two years. Grapes grow and ripen both in the warm valleys of the Thompson River and in the Southern Okanagan. Strawberry growing is capable of almost indefinite development, and at points in the Thompson River valley, along the main line of the Canadian Pacific Railway, the climatic conditions are favourable and shipping facilities excellent, and the fruit itself has a good carrying quality. Quantities of grapes are shipped to the coast, late winter apples also finding a market there. Grapes and peaches command higher prices in the north-west than they do at the coast on account of the competition from California not being so keen there. On the lower mainland apple growing has not been a pronounced success owing to the fungus disease affecting both fruit and trees. This is due to the humidity of the climate. All small fruits, however, do exceedingly well, there is a ready market, and good prices are realised. Comparatively large incomes have been made from strawberry gardens in the Lower Fraser River Valley, and points contiguous to the Canadian Pacific Railway. Melons and tomatoes cannot be relied upon to ripen in the lower mainland, except in occasional years. In Vancouver and the other islands the principal difficulty in the way of growing small fruit is the dry summer, necessitating careful cultivation of the soil. The climatic conditions otherwise are very favourable for apples, pears, plums, and cherries, and particularly for small fruit. The south-western portion of Vancouver Island is particularly anapted to strawberry growing. The quality of the berries grown in this district is excellent, and the yield very heavy. No such thing is known as a failure of the crop. Canning factories have not been a success, because the demand for fresh fruit is too great, and the price for fresh fruit too high. The prospects for jam making in British Columbia are good, as such fruits as strawberries and raspberries, and currants can be used for the manufacture of pulp for shipment to distant markets. The market for fruit pulp is Europe and the north-west.

Correspondence.

THE PROVINCE OF SIND.

As a past resident in Sind—for 21 years—I have read Mr. Birdwood's paper with great interest. I suggest that no one reading it can help being struck by (1) the extraordinary possibilities of Sind, especially of its port, Karachi; (2) the extraordinary failure of Sind - especially of its port—to have developed as might reasonably have been expected.

I submit that the reasons why Sind has been and is neglected are clear. Let us first consider the undoubted facts that we have to deal with.

(*a.*) Karachi is more than 200 miles nearer to Aden than is Bombay, and the sea passage from Aden to Karachi is free from the heavy weather of the monsoon, while the passage to Bombay runs through the heaviest monsoon weather.

(*b.*) Karachi is far nearer to Delhi than is Bombay.

(*c.*) The port of Karachi commands the Persian Gulf, and could, at comparatively little expense, be turned into a second Portsmouth, and be enlarged to deal with *all* the trade of the Suez Canal. The plans, cut and dried, for such enlargement, lie before me.

(*d.*) Troops, landed at a Karachi wharf, can be enrailed by walking a few steps from the wharf, and thence can—even now—be carried without break to the north-west and central parts of India. A few connecting links would make the line clear to Calcutta. By no possiibility could these advantages be obtained at Bombay.

(*e.*) Sind, a country of irrigation, is unaffected by the failure of the monsoon; during the late famine, the province exported wheat, and the cultivation of wheat is increasing.

(*f.*) Sind contains perhaps the finest marble quarries in the world.

I ask any business man what England should have done with such a country and such a port—the empress of the world, as Napier wrote—when it has been in her possession for fifty years?

Why has so little been done? If Disraeli's scheme—when Lord Lytton was Governor-General—for a Trans-Indus province had been carried out, would Sind and its port have been as they now are?

The neglect arises from the fact that the province of Sind is under the government of Bombay, and its interests have always been considered as subservient to those of Bombay. I make no accusations, but I say that, by the eternal verities of human selfishness, if you put one port under the government of a second established port, only 500 miles distant, then the subject port can never have a fair chance of development.

Why are the law-courts of Sind adapted for the administration of justice in a fishing village rather than for the decision of cases arising where a port has a larger trade than Madras itself? Why is Karachi not used as a trooping station? I have reason to believe—from what I am personally acquainted with—that Mr. Benedict is wrong in saying that the rest camps were found too expensive. Why was not the direct line of railway from Karachi to Delhi made? A line that stragetically would have established an interior line of defence, and commercially would have brought Delhi 120 miles nearer the sea than it now is, opened up the working of valuable marble quarries and staved off possible famine from a

great district? Why are not the mails for the North-West and part of Central India carried through Karachi, so that days in delivery may be saved?

The questions above put touch but the fringe of Sind's misfortunes. The questions really are these:—

Would the misfortunes continue to exist if Sind were under a separate government? If Karachi were the capital of a separate presidency, or under a lieutenant-governor, what would result?

F. C. CONSTABLE.

DEVELOPMENT OF THE ST. LOUIS EXHIBITION.

Now that the Royal Commission on the St. Louis Exhibition are soliciting and receiving formal applications for space in the various departments, it may not be amiss to give some information about tariff duties, the facilities for getting exhibits through the Custom-houses, the rates of freight on the railways to and from the coast, the plans for the admission of labourers, and some notice of the progress of the work of preparation.

No duties will be levied upon exhibits except those sold for delivery after the close of the Exhibition, in which case they will pay the regular taxes fixed by law. Goods intended for exhibition may be shipped to any port whence they will be transported in bond to the Exhibition grounds—made by law a bonded warehouse—in which the goods will remain until their removal before March 1st, 1905. If not sold, they will be returned to the country of origin through the port of entrance. The Revenue officers, of which there will be more than five hundred on the grounds, acting with the Division of exhibits, will exercise a close supervision of foreign goods, collect duties upon those sold, superintend the packing in the original cases of those returned, and supervise reshipment in bonded cars to the proper seaport. Personal supplies for the use of foreign commissioners in attendance at the Exhibition, samples of merchandise for distribution, descriptive advertising matter, and the portions of exhibits necessary for the juries of award, will be admitted free of duty.

For the purpose of facilitating the admission of foreign exhibits, the Government of the United States and the Exhibition have appointed Mr. I. P. Roosa, United States despatch agent, as their joint official representative. He will receive, at the port of New York, exhibits consigned to him, will carry out the forms laid down by the Government and the Exhibition, afford whatever assistance may lie in his power, and have the exhibits placed in bonded cars for through shipment to the Exhibition grounds. All this will be done, both going and returning, without charge of any kind for the agent's services. The exhibitor will, of course, pay the actual cost of cartage and transfer, which will, in general, be small. For the larger consignments inclusive rates from the British coast to St. Louis will no doubt be arranged. The freight rates are simple. All communicating railways will carry exhibits in bond from the landing port to St. Louis at a single full rate, which will entitle the exhibitor, after the close of the Exhibition, to the free return of his goods to the same port. It is scarcely necessary to explain that in America, as everywhere else, freight rates vary according to the class of goods. The Royal Commission will, no doubt, in due time make public its own arrangements for reduced ocean rates, and also announce any plans it may form for giving assistance in the matter of transportation charges on collective or other exhibits.

In order that foreign exhibitors may not be hampered by the provisions of the Contract Labour law and regulations, the Congress of the United States has passed a special Act providing for the admission of foreign labourers for the purpose of preparing, making, and caring for exhibits. When they arrive at any port the Commissioner, or the Collector of Customs, will satisfy himself that such labourers are entitled to admission under the Act in question, and will issue a certificate to that effect to each one. This permit will be valid for three months after the close of the Exhibition, and must be surrendered upon the return of the holder to his own country. The law and the regulations under it have been made very short and simple, in order that complications or difficulties may be avoided.

Thus far about £2,000,000 has been spent by the management. This includes the preparation of the grounds, and the cost of exploitation in foreign countries and at home, but the principal part of it has gone into buildings. Of these, ten are now fairly complete, and it is expected that all will be practically finished by the end of the current year. This of course refers to those provided for exhibits, and not to those of States and foreign countries, although many of them are under weigh and some have been completed and transferred to their owners. The exhibit buildings proper will cover about 200 acres of the 1,200 acres of the site. Besides, the water features of the Exhibition, and also an elaborate fire protection plant, to cost £100,000, are in a state approaching completion. The electric lighting, the buildings for the Concessions Department and the various meeting halls are also well under weigh. The money appropriated by the United States Government, £1,000,000, will become available on the 1st of September, so that there is little danger of that lack of funds which sometimes accompanies these vast enterprises.

Thus far nothing has interfered with the steady, consistent development of the scheme. There is every reason to expect that it will open at the time fixed, and be carried on with the same success that has marked its organisation and preliminary management.

GEORGE F. PARKER,
Commissioner.

Sanctuary House, Westminster, July 18th.

Journal of the Society of Arts,

No. 2,645. Vol. LI.

FRIDAY, JULY 31, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ALBERT MEDAL.

The Council of the Society attended at Marlborough House on Monday, the 27th instant, when His Royal Highness the Prince of Wales, President of the Society, presented the Albert Medal to Sir Charles Augustus Hartley, K.C.M.G., "in recognition of his services, extending over forty-four years, as Engineer to the International Commission of the Danube, which have resulted in the opening up of the navigation of that river, to the ships of all nations, and of his similar services, extending over twenty years, as British Commissioner on the International Technical Commission of the Suez Canal." The members of the Council present were: Sir Steuart Colvin Bayley, K.C.S.I., C.I.E.; Sir M. M. Bhownaggree, K.C.I.E., M.P.; Sir George Birdwood, K.C.I.E., C.S.I.; Sir Frederick Bramwell, Bart., F.R.S.; Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.; Hon. Sir Charles Fremantle, K.C.B.; Robert Kaye Gray; Colonel Sir Robert Holdich, R.E., K.C.M.G.; Sir William Lee Warner, K.C.S.I.; Hon. Richard Clere Parsons, M.A.; Sir Westby Perceval, K.C.M.G.; Sir Owen Roberts, M.A., D.C.L.; Carmichael Thomas; Sir John Wolfe Barry, K.C.B., F.R.S.; with Sir Henry Trueman Wood, M.A. (Secretary), and Henry B. Wheatley (Assistant Secretary).

EXAMINATIONS.

The results of the Preliminary Examinations (Grade I.) for the present year, held in March and April last, will be issued next week.

The dates for the Examinations in 1904 (Grade I. Elementary, and Grade II. General) will be March 21, 22, 23, and 24. The last day for receiving entries will be February 24.

Proceedings of the Society.

CANTOR LECTURES.

HERTZIAN WAVE TELEGRAPHY.*

By Dr. J. A. Fleming, F.R.S.

Lecture II.—Delivered March 9th, 1903.

Transmitting Arrangements and Transmitters.

In the last lecture, your attention was directed to the manner in which electrical oscillations set up in the aerial create an effect called an electric wave in the surrounding space. It was shown that these oscillations are excited by charging an electrical reservoir of some kind, it may be the aerial itself, or some other condenser, and then releasing this charge suddenly across an air gap in the form of an electric spark.

We have now to consider the appliances for creating the necessary charging electromotive force, and for storing and releasing this charge at pleasure, so as to generate the required electrical oscillations in the aerial. It is essential that this generator, whatever its nature, should be able to create not only large potential difference, but also a certain minimum electric current. Accordingly, we are limited at the present moment to one of two appliances, viz., the induction coil or the alternating current transformer.

It will not be necessary to enter into an explanation of the action of the induction coil, you are all doubtless well acquainted with it. The coil generally employed for wireless telegraphy is technically known as a 10-inch coil, that is, a coil which is capable of giving a 10-inch spark between pointed conductors in air, at an ordinary pressure. The construction of a large coil of this description is a matter requiring very great technical skill, and is not to be attempted without considerable previous experience in the manufacture of smaller coils. The secondary circuit of a 10-inch coil is formed of double silk-covered copper wire, generally speaking, either the gauge called No. 36 or No. 34 B.W.G. is used, and a length of ten to seventeen miles of wire is employed on the secondary circuit, according to the gauge of wire selected. For the precautions necessary

* The blocks illustrating these lectures have been kindly lent by the Proprietors of *Engineering*.

in constructing the secondary coil, practical manuals must be consulted.*

Very great care is required in the insulation of the secondary circuit of an induction coil to be used in Hertzian wave telegraphy, because the secondary circuit is then subjected to impulsive electromotive forces lasting for a short time, having a much higher electromotive force than that which the coil itself normally produces.

The primary circuit of a 10-inch coil generally consists of a length of 300 or 400 feet of much stouter copper wire. In the coil before me the secondary circuit consists of ten miles of No. 34 H.C. copper wire, making about 50,000 turns round the core. It has a resistance at ordinary temperatures of 6,600 ohms, and an inductance of 460 henrys. The primary circuit consists of 360 turns of No. 12 H.C. copper wire, and has a resistance of 0·36 of an ohm, and an inductance of 0·02 of a henry. The mutual inductance between the primary and secondary circuit is 2·74 henrys, and the coil will give a 10-inch spark. The other coil on the table, which will give a 6-inch spark, has a primary circuit having a resistance 0·426 of an ohm, and an inductance 0·013 of a henry. The secondary circuit is wound with much finer wire than the 10-inch coil, and has a resistance of 9,750 ohms, and an inductance of 234 henrys. The mutual inductance between the primary and secondary circuit is 1·5 henrys.

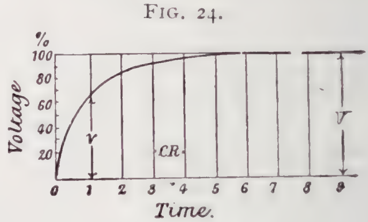
An important matter in connection with an induction coil to be used for wireless telegraphy is the resistance of the secondary circuit. The purpose for which we employ the coil is to charge a condenser of some kind. If a constant electromotive force, V, is applied to the terminals of a condenser having a capacity, C, then the difference of potential, v, of the terminals of the condenser at any time t seconds after the contact is made, is given by the expression:—

$$v = V\left(1 - e^{-\frac{t}{RC}}\right)$$

In the above equation the letter e stands for the number 2·71828, the base of the Napierian logarithms, and R is the resistance in megohms in series with the condenser, having the capacity C microfarads, through which the electromotive force is supplied. This equation can easily be deduced from first principles,* and it shows that the potential difference, v, of the terminals of the condenser does not instantly attain a value equal to that of the steady impressed electromotive force V, but that it rises up gradually. Thus, for instance, suppose that a condenser of one microfarad is being charged through a resistance of one megohm, by an impressed constant voltage of 100 volts, the equation shows that at the end of the first second after contact, the terminal potential difference of the condenser will be only 63 volts, at the end of the second second, 86 volts, and so on. (See Fig. 24.)

Since e^{-10} is an exceedingly small number; in ten seconds the condenser would be practically charged with a voltage equal to 100 volts. The product C R in the above equation, is called the *time-constant* of the condenser, and we may say that the condenser is practically charged after an interval of time equal to ten

FIG. 24.



$$v = V\left\{1 - (2.718)^{-\frac{t}{CR}}\right\}$$

TERMINAL VOLTAGE OF A CONDENSER OF CAPACITY, C, CHARGED THROUGH RESISTANCE, R.

C. Measured in Microfarads.
R. „ „ Meghoms.

times the time-constant, counting from the moment of first contact between the condenser and the source of constant voltage. The time-constant is to be reckoned as the product of the capacity (C) in microfarads by the resistance of the charging circuit (R) in megohms. To take another illustration. Supposing we are charging a condenser having a capacity of one-hundredth of a microfarad through a resistance of 10,000 ohms. Since 10,000 ohms is equal to 100th of a microfarad, the time-constant would be equal to one ten-thousandth of a second, and ten times this time-constant would be equal to a thousandth of a second. Hence, in order fully to charge the above capacity through the above resistance, it is necessary that the contact between the source

* Instructions for the manufacture of large induction coils may be obtained from a Treatise on the Construction of Large Induction Coils by A. T. Hare. (Methuen and Co.) Also see vol. 2. of "The Alternate Current Transformer," by J. A. Fleming, chapter I. (The Electrician Publishing Co., 1, Salisbury-court, Fleet-street, E.C.)

* See "The Alternate Current Transformer," by J. A. Fleming, vol. 1, p. 184.

of voltage and the condenser should be maintained for at least one-thousandth part of a second.

In discussing the methods of interrupting the circuit, I shall return to this matter, but meanwhile it may be said that in order to secure a small time-constant for the charging circuit, it is desirable that the secondary circuit of the induction coil should have as low a resistance as possible. This, of course, means winding the secondary circuit with a rather thick wire. If, however, we employ a wire much larger in size than No. 34, or, at the most, No. 32, the bulk and the cost of the induction coil begin to rise very rapidly. Hence, as in all other departments of electrical construction, the details of the design are more or less a matter of compromise. We cannot have all that we should like; but we are able to obtain it to some extent. Generally speaking, however, it may be said that the larger the capacity which is to be charged, the lower should be the resistance of the secondary circuit of the induction coil.

In the practical construction of induction coils for wireless telegraphy, manfacturers have followed too much the stock design of the instrument maker. You are all familiar with the appearance of the instrument maker's induction coil; its polished mahogany base, its lacquered brass fittings, and its secondary bobbin constructed of and covered with ebonite. But such a coil, although it may look pretty on the lecture table, is yet very unsuited to positions in which it may be used in connection with Hertzian wave telegraphy. On board ship, in lighthouses, or in lonely huts in exposed situations, the instrument maker's pattern of induction coil not only soon loses its appearance and polish, but it often comes very soon to grief. The coil ought to be so completely waterproof that it will almost bear being put under water without injury. Three important adjuncts of the induction coil are the primary condenser, the interruptor, and the primary key. The interruptor is the arrangement for intermitting the primary current. We have, in some way or other, rapidly to interrupt the primary current, and the torrent of sparks that then appear between the secondary terminals of the coil are due to the electromotive force set up in the secondary circuit at each break or interruption of the primary circuit. We may divide interruptors into five classes.

We have first the well-known *hammer interruptor*, which Continental writers generally attribute to Neef or Wagner.* In this interruptor, the magnetisation of the iron core of the coil is caused to attract a soft iron block fixed at the top of a brass spring, and by so doing to interrupt the primary circuit between two platinum contacts. Mr. Apps added an arrangement for pressing back the spring against the back contact, and the form of hammer break that is now generally employed is therefore called an Apps break.

As the 10-inch coil takes a current of 10 amperes at 16 volts, when in operation, it requires very substantial platinum contacts to stand this current continuously without damage. The small platinum contacts that are generally put on these coils by instrument makers are very soon worn out in practical wireless telegraphy work. If a hammer break is used at all, it is essential to make the contacts of very substantial pieces of platinum, and from time to time, as they get burnt away or roughened, they must be smoothed up with a fine file. It does not require much skill to keep the hammer contacts in good order, and prevent them from sticking together and becoming damaged by the break spark.

By regulating the pressure of the spring against the back contact, by means of an adjusting screw, the rate at which the break vibrates can be regulated, but, as a rule, it is not possible with a hammer break to obtain more than 800 interruptions per minute, or, say, 12 a second. The hammer break is usually operated by the magnetism of the iron core of the coil, but for some reasons it is better to separate the break from the coil altogether, and to work it by an independent electromagnet, which, however, may be excited by a current from the same battery which supplies the induction coil. For coils up to the 10-inch size the hammer break is sufficiently good when very rapid interruptions are not required. It is not in general practicable to work coils larger than the 10-inch size with a platinum contact hammer break, as such a butt contact becomes overheated and sticks if more than 10 amperes is passed through it. In the case of larger coils, we have to employ some form of interruptor in which mercury or a conducting liquid forms one of the contact surfaces.

The next class of interruptor is the *vibrating* or *hand-worked mercury break*, in which a platinum or steel pin is made to vibrate in and

* Du Moncel states that MacGauley of Dublin independently invented the form of hammer break, as now used. See "The Alternate Current Transformer," vol. 2, chap. I. J. A. Fleming.

out of mercury. This movement may be effected by the attraction of an iron armature by an electromagnet, or by the varying magnetism of the core of the coil, if desired to be rapid, or it may be effected more slowly by hand.

The mercury surface must be covered with water, alcohol, paraffin, or creosote oil, to prevent oxidation and to extinguish the break spark. The interruption of the primary current obtained by the mercury break is more sudden than that obtained by the platinum contact in air, in consequence of the more rapid extinction of the spark; hence the sparks obtained from coils fitted with mercury interruptors are generally from twenty to thirty per cent. longer than those obtained from the same coil under the same conditions, with platinum contact interruptors. The mercury breaks will, however, not work well unless cleaned at regular intervals by emptying off the oil and rinsing well with clean water, and hence they require rather more attention than platinum interruptors. It is not generally possible to obtain so many interruptions per minute with the simple vibrating mercury interruptor, as with the ordinary hammer interruptor. The mercury interruptor has, however, the advantage that the contact time during which the circuit is kept closed may be made longer than is the case with the hammer break. Also if fresh water is allowed to flow continuously over the mercury surface, it can be kept clean and the break will then operate for considerable periods of time without attention.

The mercury interruptor may be worked by a separate electro-magnet, or by the magnetism of the core of the induction coil.

The third class of interruptor may be called the *motor interruptor*, of which a large number have been invented in recent years. In this interruptor, some form of a continuously rotating electromotor is employed to make and break a mercury or other liquid contact. In one simple form, the motor shaft carries an eccentric which simply dips a platinum point into mercury, or else a platinum horsehoe into two mercury surfaces, making in this manner an interruption of the primary circuit at one or two places. As a small motor can easily be run at twelve hundred revolutions per minute, or twenty per second, it is possible easily to secure in this manner a uniform rate of interruption of the primary current at the rate of about twenty per second. If, however, much higher speeds are employed, then the time of contact becomes abbreviated, and the action of the coil in charging the capacity is diminished.

Professor J. Trowbridge has described an effective form of motor break for large coils in which the interruption is caused by withdrawing a stout platinum wire from a dilute solution of sulphuric acid, and by this means he increased the fifteen-inch spark given by a coil provided with hammer break and condenser to thirty inches, when using the liquid break, and no condenser.*

A good form of motor interruptor, due to Dr. Mackenzie Davidson, consists of a slate disc bearing pin contacts fixed on the prolonged steel axle of a motor placed in an inclined position; the disc and the lower part of the axle lie in a vessel filled one-third with mercury and two-thirds with paraffin oil. The circuit is made and broken by the revolution of the disc, causing the pins to enter and leave the mercury. The speed of the motor can be regulated by a small resistance, and can be adapted to the electromotive force used in the primary circuit. When the motor is running slowly the interruptor can be used with a low electromotive force, that is to say, something between twelve and twenty volts, but with a higher speed a larger electromotive force can be used without danger of overheating the primary coil, and with an electromotive force of about 50 volts, the interruptions may be so rapid that an unbroken arc of flame, resembling an alternating current arc, springs between the secondary terminals of the coil.

Mr. Tesla has devised numerous forms of rotating mercury break. In one a star-shaped metal disc revolves in a box so that its points dip into mercury covered with oil and make and break contact. In another form, a jet of mercury plays against a similar shaped rotating wheel.

For details the reader must consult the fuller descriptions in the "Electrical World," of New York, vol. 32, p. 111, 1898 (or "Science Abstracts," vol. 2, p. 46, and p. 457, 1898; also vol. 33, p. 247.)

The fourth class of interruptor is called a *turbine interruptor*. In this appliance a jet of mercury is forced out of a small aperture by means of a centrifugal pump, and is made to squirt against a metal plate, and interrupted intermittently by a toothed wheel made of insulating material, rotated by the motor which drives the pump. The current supplying the coil passes through or along this jet of mer-

* See Prof. J. Trowbridge, "On the Induction Coil." *Phil. Mag.*, April, 1902, vol. 3, sec. 6. p. 393.

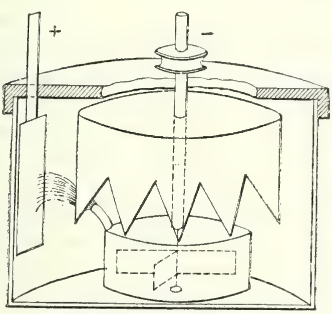
cury, and is therefore rendered intermittent when the wheel revolves.

In the case of this interruptor, the duration of the contacts, as well as a number of interruptions per second, is under control, and for this reason, better results are probably obtained with it than with any other form of break.

A description of a turbine mercury break devised by M. Max Levy, was given in the "Elektrotechnische Zeitschrift," vol. 20, p. 717, October 12th, 1899 (see also "Science Abstracts," vol. 3, p. 63. Abstract No. 165), as follows:—

A toothed wheel made of insulating material carries from six to twenty-four teeth, and as it can be made to rotate from 300 to 3,000 times per minute, the interruptions can be regulated between 5 and 400 per second. (See Fig. 25.)

FIG. 25.



Mercury Turbine Break.

Moreover, by raising or lowering the position of the jet of mercury, and that of the plate against which it strikes, the duration of the contact can be varied so that it is possible to regulate this period without disturbing the number of interuptions per second.

The sparks obtained from a coil worked with a turbine interruptor have more *quantity* than the sparks obtained with any other interruptor under similar conditions, and the coil can be worked with a far higher voltage than is possible when using the hammer break. In this manner the appearance of the secondary sparks can be varied from the thin snappy sparks given by the hammer break to the thick flame-like arc sparks given by the electrolytic break. This break can be adapted for any voltage from 12 to 250 volts, and the primary circuit cannot be closed before the interruptor is acting. The mercury in the break is generally covered with alcohol or paraffin oil to reduce oxidation, and the appliance is nearly noiseless when in operation. The mercury has to be cleaned at intervals if the interruptor is much used. If alcohol is used to cover the mercury, the cleaning is very simple; the break requires only to be rinsed under a water tap. When paraffin oil is used, the cleaning is generally effected with the help of a few ounces of sulphuric acid, in a few minutes. It is best, however, to clean the mercury continuously by allowing water to flow over it.

The motor driving the centrifugal pump and the fan, can be wound for any voltage, and it is best to have it so arranged that this motor works on the same battery which supplies the primary circuit of the coil, the two circuits working parallel together. A rheostat can be added to the motor circuit to regulate the speed.

The turbine break driven by an independent motor, which is kept always running, has another advantage over the hammer break in practical wireless telegraphy, viz., that a useful secondary spark can be secured with a shorter time of closure of the primary circuit since there is no inertia to overcome as in the case of the hammer break. This latter form has only continued in use because of its simplicity and ease of management by ordinary operators.

Lastly, we have the *electrolytic interruptors*, the first of which was introduced by Dr. Wehnelt, of Charlottenberg, in the year 1899, and modified by subsequent inventors. In its original form, a glass vessel filled with dilute sulphuric acid, one of acid to five or else ten parts of water, contains two electrodes of very different sizes; one is a large lead electrode formed of a piece of sheet lead laid round the interior of the vessel, and the other is a short piece of platinum wire projecting from the end of a glass or porcelain tube. The smaller of these electrodes is made the positive, and the large one the negative. If this electrolytic cell is connected in series with the primary circuit of the induction coil (the condenser being cut out), and supplied with an electromotive force from 40 to 80 volts, an electrolytic action takes place which interrupts the current periodically.* An enormous number of interruptions can, by suitable adjustment, be produced per second, and the appearance of a discharge from the secondary terminals of the coil, while using the Wehnelt break, more resembles an alternate current arc, than the usual disruptive spark.

* See Dr. Wehnelt's article in the "Electrotechnische Zeitschrift," January 26th, 1899.

At the time when the Wehnelt break was first introduced, great interest was excited in it, and the technical journals in 1899 were full of discussions as to the theory of its operation.† The general facts concerning the Wehnelt break are that the electrolyte must be dilute sulphuric acid in the proportion of one of acid to five or ten of water. The large lead plate must be the cathode, or negative pole, and the anode, or positive pole, must be a platinum wire about a millimeter in diameter, and projecting one or two millimeters from the pointed end of a porcelain, glass, or other acid-proof insulating tube. The aperture through which the platinum wire works must be so tight that acid cannot enter, yet it is desirable that the platinum wire should be capable of being projected more or less from the aperture by means of an adjusting screw. The glass vessel which contains these two electrodes should be of considerable size, holding say a quart of fluid, and it is better to include this vessel in a larger one in which water can be placed to cool the electrolyte, as the latter gets very warm when the break is used continuously. If such an electrolytic cell has a continuous electromotive force applied to it tending to force a current through the electrolyte from the platinum wire to the lead plate, we can distinguish three stages in its operation, which are determined by the electromotive force and the inductance in the circuit. First, if the electromotive force is below 16 or 20 volts, then ordinary and silent electrolysis of the liquid proceeds, bubbles of oxygen being liberated from the platinum wire and hydrogen set free against the lead plate. If the electromotive force is raised above 25 volts, then if there is no inductance in the circuit the continuous flow of current proceeds, but if the circuit of the electrolyte possesses a certain minimum inductance, the character of the current flow changes, and it becomes intermittent, and the cell acts as an interruptor, the current being interrupted from a hundred to two thousand times per second, according to the electromotive force and the inductance of the circuit. Under these conditions the cell produces a rattling noise, and a luminous glow appears round the top of the platinum wire. Thus, in a particular case, with an inductance of 0·004 millihenry in the circuit of a Wehnelt break, no interruption of the circuit took place, but with one millihenry of inductance in the circuit, and with an electromotive force of 48 volts, the current became intermittent at the rate of 930 per second, and by increasing the voltage to 120 volts, the intermittency rose to 1850 a second.

The Wehnelt break acts best as an interruptor with an electromotive force from 40 to 80 volts. At higher voltages a third stage sets in; the luminous glow round the platinum wire disappears, and it becomes surrounded with a layer of vapour as observed by MM. Violle and Chassagny; the interruptions of current cease, and the platinum wire becomes red hot. If there is no inductance in the circuit the interruptor stage never sets in at all, but the first stage passes directly into the third stage. In the first stage bubbles of oxygen rise steadily from the platinum wire, and in the interrupted stage they rise at longer intervals, but regularly. The cell will not, however, act as a break at all unless some inductance exists in the circuit.

In applying the Wehnelt break to an induction coil the condenser is discarded, and also the ordinary hammer break, and the Wehnelt break is placed in circuit with the primary coil. In some cases the inductance of the primary coil alone is sufficient to start the break in operation, but with voltages above fifty or sixty it is generally necessary to supplement the inductance of the primary coil by an additional inductance coil. The best form of Wehnelt break for operating induction coils is the one in multiple anodes (*see* Dr. Marchant, "The Electrician," vol. 42, p. 841, 1899), and when it has to be used for long periods the kathode may advantageously be formed of a spiral of lead pipe through which cold water is made to circulate.

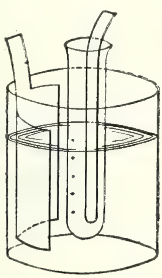
Another form of electrolytic break was introduced by Mr. Caldwell. In this, a vessel containing dilute sulphuric acid is divided into two parts. (See Fig. 26.) In the partition is a small hole, and in the two compartments are electrodes of sheet lead. The small hole causes an intermittency in the current which converts the arrangement into a break. Mr. Campbell Swinton modified the above arrangement by making the partition to consist of a sort of porcelain test tube with a hole in the bottom. This hole can be more or less plugged up by a glass rod drawn out to a point, and this is used to

† See *Electrician*, vol. 42, 1899, pp. 721, 728, 731, 732, and 842; communications from Mr. Campbell Swinton, Prof. S. P. Thompson, Dr. Marchant, the author, and others. Also p. 864 of same volume, for a leader on the subject. Also p. 870, letters by M. Blondel and Prof. E. Thomson. See also *Electrician* vol. 43, p. 5, 1899, extract from a paper by P. Barry, *Comptes Rendus*, April 10th, 1899. See also *The Electrical Review*, vol. 44, p. 235, 1899, February 17th.

adjust the size of the hole. (See Fig. 27.) This porcelain vessel contains dilute acid, and stands in a larger vessel of acid, and lead electrodes are placed in both compartments. The current and intermittency can be regulated by more or less closing the aperture between the two regions.

When the Wehnelt break is applied to an ordinary 10-inch induction coil, and the inductance of the primary circuit and the electromotive force varied until the break interrupts the current regularly, and with the frequency of some hundred a second, the character of the secondary discharge is entirely different from its appearance with the ordinary hammer break. The thin blue lightning-like sparks are then replaced by a thicker mobile flaming discharge, which resembles an alternating current arc, and when carefully examined or

FIG. 26.



CALDWELL BREAK.

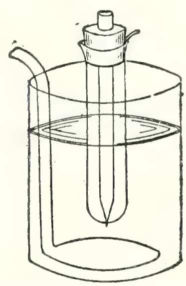
photographed, is found to consist of a number of separate discharges superimposed upon one another in slightly different positions.

Many theories have been adopted as to the action of the break, but time will not permit us to examine these. Professor S. P. Thompson and Dr. Marchant have suggested a theory of resonance.* One difficulty in explaining the action of the break is created by the fact that it will not work if the platinum wire is made a cathode.

Although the Wehnelt break has some advantages in connection with the use of the induction coil for Röntgen ray work, its utility as far as regards Hertzian wave telegraphy is not by any means so marked. It has already been explained that in order to charge a condenser of a given capacity at a constant voltage the electromotive force must be applied for a certain minimum time which is determined by the value of the capacity and the resistance of the secondary circuit of the induction coil. If the coil is a 10-inch coil, and has a secondary resistance of say 6,000 ohms, and if the capacity to be charged has a value say of 1-30th of a microfarad, then the time-constant of the circuit is one five-thousandth of a second. Therefore, the electromotive force charging the condenser must be maintained for at least one five-hundredth of a second, so that the condenser may become charged to the voltage which the coil is then producing.

In the induction coil, the electromotive force generated in the secondary coil at the "break" of the primary current, is higher than that at the "make," and the magnitude and duration of this electromotive force, other things being equal, depends upon the rate at which the magnetism of the iron core dies away, and its duration is shorter in proportion as the whole time occupied in the disappearance of the

FIG. 27.



CAMPBELL-SWINTON BREAK.

magnetism is less. The Wehnelt break does not increase the actual secondary electromotive force, nor apparently its duration, but it greatly increases the number of times per second the electromotive force makes its appearance. Hence this break increases the current, but not the electromotive force in the secondary coil. It therefore does not assist us in the direction required, viz.: in prolonging the duration of the secondary electromotive force to enable larger capacities to be charged.

The important point in connection with the working of a coil used for charging a condenser, is not the length of the spark which the coil can give alone, but the length of spark which can be obtained between small balls attached to the secondary terminals, when these terminals are also connected to the two surfaces of the condenser. Thus, a coil may give a 10-inch spark if worked alone, but on a capacity of 1-30th of a microfarad, it may not be able to give even a five-millimeter spark. Hence in describing the value of a

* See *The Electrician*, vol. 42, 1899, pp. 731 and 841.

coil for wireless telegraph purposes, it is not the least use to state the length of spark which the coil will give between the pointed conductors in air, but we must know the spark length which it will give between brass balls say one centimeter in diameter, connected to the secondary terminals, when these terminals are also short-circuited by a stated capacity, the spark not exceeding that length at which it becomes non-oscillatory.

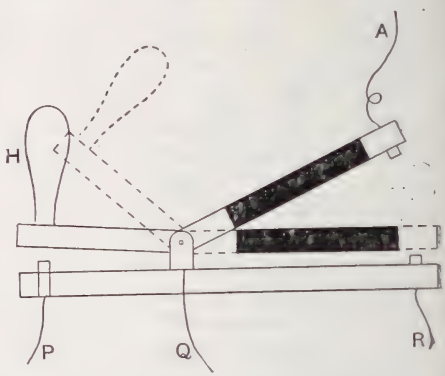
A good way of describing the value of an induction coil for wireless telegraph purposes is to state the length of oscillatory spark which can be produced between balls one centimeter in diameter connected to the secondary terminals when these balls are short-circuited by a condenser having a capacity, say, of one-hundredth of a microfarad, and also of one-tenth of a microfarad.

If a hammer or motor interruptor is employed with the coil then a primary condenser must be connected across the points between which the primary circuit is broken. This condenser generally consists of sheets of tinfoil, alternated with sheets of paraffin paper, and for a 10-inch coil may have a capacity of about 0·4 or 0·5 of a microfarad.*

Lord Rayleigh discovered that if the interruption of the primary circuit is sufficiently sudden and complete, as when the primary circuit is severed by a bullet from a gun, the primary condenser can be removed, and yet the sparks obtained from the secondary circuit are actually longer than those obtained with the condenser and the ordinary break.† In the use, however, of the coil for Hertzian wave telegraphy with all interruptors except the Wehnelt break, a condenser of suitable capacity must be joined across the break points.

Turning, in the next place, to the primary key or signalling interruptor, it is necessary to be able to control the torrent of sparks between the secondary terminals of the coil and to cut them up into long and short periods in accordance with the letters of the Morse alphabet. This is done by means of the primary key. The primary key generally consists of an ordinary massive single contact key with heavy platinum contacts. As the current to be interrupted amounts to about 10 amperes, and is flowing in a highly inductive circuit, the spark at break is considerable. If the attempt is made to extinguish this spark by making the contacts move rapidly away from one another through a long distance, in other words, using a key with a wide movement, then the speed at which the signals can be sent is greatly diminished. The speed of sending greatly depends upon the time taken to move the key up and down between sending two dots, and hence a short range key sends quicker than a long range key. If it is desired to use a short range key, then some method must be employed to extinguish the spark at the contacts. This is done in one of three ways; By using a high resistance coil to short circuit these contacts, or by a condenser, or by a magnetic blow-out, as in the case of an electric tramcar circuit controller. Of these the magnetic blow-out is probably the best.

FIG. 28.



MARCONI'S SIGNALLING KEY.

P, Q. Connections to primary circuit of coil.
A. Connection to aerial.
R. Connection to receiver.
H. Handle.

Mr. Marconi has designed a signalling key which performs the function not only of interrupting the primary circuit but at the same time breaks connection between the receiving appliance and the aerial. The details of this appliance can be best understood by the diagram in Fig. 28.

I have designed for signalling purposes a multiple contact key which interprets the circuit simultaneously in ten or twelve different places. The particular point about this break is the means which are taken to make the twelve interruptions absolutely simultaneous. If these interruptions are not simultaneous, the spark always takes place at the contact which is broken first, but if the circuit is interrupted in a dozen places quite simultaneously, then the spark is cut up into a dozen different portions, and the spark at each contact is very

* For a discussion of the function of the condenser in an ordinary induction coil, see "The Alternate Current Transformer," by J. A. Fleming, vol. 2. p. 51.

† See Lord Rayleigh, *Phil. Mag.*, December, 1901.

much diminished. By this break voltages up to 2,000 volts may be quite easily dealt with.

Various forms of break have been devised, in which the circuit is broken under oil or insulating fluids, but, generally speaking, these devices are messy in use, and a dry contact between platinum surfaces, with appropriate means for cutting up the spark and blowing it out, so that the mechanical movement of the switch may be small, is the best thing to use.

The signalling key is really a very important part of the transmitting arrangement, because whatever may be the improvements in receiving instruments, it is not possible to receive faster than we can send. A great many statements have appeared in the daily papers as to the possibility of receiving hundreds of words a minute by Hertzian wave telegraphy, but the fact remains that whatever may be the sensibility of the receiving appliance, the rate at which telegraphy of any kind can be conducted is essentially dependent upon the rate at which the signals can be sent, and this in turn is largely dependent upon the mechanical movement which the key has to make to interrupt the primary circuit, and so interrupt the secondary discharge.

In order to make the separation of the contact points of the switch as small as possible, and yet prevent an arc being established, various blow-out devices have been employed. The simplest arrangement for this purpose is a powerful permanent magnet so placed that its interpolar field embraces the contact points and is at right angles to them.

As already explained, the applicability of the induction coil in wireless telegraphy is limited by the fact of the high resistance of the secondary circuit, and the small current that can be supplied from it. Data are yet wanting to show what is the precise *efficiency* of the induction coil, as used in Hertzian wave telegraphy, but there are reasons for believing that it does not exceed 50 or 60 per cent.

Where large condensers have to be charged, in other words, where we have to deal with larger powers, we are obliged to discard the induction coil and to employ the alternating current transformer. But this introduces us to a new class of difficulties. If an alternating current transformer, wound for a secondary voltage, say of 20,000 or 30,000 volts, has its primary circuit connected to an alternator, then if the secondary terminals, to which are connected two spark balls, are gradually brought within striking distance of one another, the moment we do this an alternating current arc starts between these balls. If the transformer is a small one, there is no difficulty in extinguishing this arc by withdrawing the secondary terminals, but if the transformer is a large one, say of 10 or 20 kilowatts, dangerous effects are apt to ensue when such an experiment is tried. The short circuiting of the secondary circuit almost entirely annuls the inductance of the primary circuit. There is therefore a rush of current into the transformer, and if it is connected to an alternator, of low armature resistance, the fuses are generally blown and other damage done. Let us suppose then that the secondary terminals of the transformer are also connected to a condenser. On bringing together the spark balls connected with the secondary terminals, we may have one or more oscillatory discharges, but the process will not be continuous, because the moment that the alternating current arc starts between the spark balls, it reduces their difference of potential to a comparatively low value, and hence the charge taken by the condenser is very small, and moreover, the circuit is not interrupted periodically so as to restart a train of oscillations.

When therefore we desire to employ an alternating current transformer as a source of electromotive force, although it may have the advantage that the resistance of the secondary circuit of the transformer is generally small compared with that of the secondary circuit of an induction coil, yet nevertheless we are confronted with two practical difficulties—(1) how to control the primary current flowing into the transformer, and (2) how to destroy the alternating current arc between the spark balls and reduce the discharge entirely to the disruptive or oscillatory discharge of the condenser.

The control over the current can be obtained in accordance with a plan suggested by me, by inserting in the primary circuit of the transformer two variable choking coils. The form in which I prefer to construct these is that of a cylindrical bobbin standing upon a laminated cross-piece of iron. These bobbins can have let down into them an E-shaped piece of laminated iron, so as to complete the magnetic circuit and thus raise the inductance of the bobbin. By placing two of these variable choking coils in series with the primary circuit, the current is under perfect control. We can determine upon a minimum value below which the current shall not fall by adjusting the position of the cores of these

two choking coils, and we can then cause that current to be increased up to a certain limit which it cannot exceed, by short-circuiting one of these choking coils by an appropriate switch. Several ways have been suggested for extinguishing the alternate current arc which forms between the spark balls connected to the secondary terminals, when these are brought within a certain distance of one another. One of these was due to Mr. Tesla. He places a strong electromagnet so that its lines of magnetic flux pass transversely between the spark balls. When the discharge takes place, the electric arc is blown out, but if the balls are short-circuited by a condenser, the oscillatory discharge of the condenser still takes place across the spark gap. Professor Elihu Thomson achieves the same result by employing a blast of air thrown on the spark gap. This has the effect of destroying the alternating current arc, but still leaves the oscillating discharge of the condenser. The action is somewhat tedious to explain in words, but you can easily understand that the blast of air, by continually breaking down the alternating current arc which tends to form, allows the condenser connected to the spark balls to become charged with the potential of the secondary circuit of the transformer, and that this condenser then discharges across the spark gap, producing an oscillatory discharge in the usual manner. I have myself found that without the use of any air blast or electromagnet, simple adjustment of the double choking coil in the primary circuit of the transformer, is sufficient to bring about the desired result when the capacity of the condenser is adjusted to be in resonance.

Another method, which has been adopted by M. D'Arsonval, is to cause the spark to pass between two balls placed at the extremities of metal rods, which are in rapid rotation, like the spokes of a wheel. In this case, the draught of air produced by the passage of the spark balls, blows out the arc, and performs the same function as the blast of air in Professor Elihu Thomson's method. When these adjustments are properly made, it is possible, by means of a condenser, and an alternating current transformer, supplied with current from an alternator, to ereate a rapidly intermittent oscillatory discharge, the sparks of which succeed one another so quickly that it appears almost continuous. When using a large transformer and condenser, the noise and brilliancy of these sparks is almost unbearable, and the eyes may be injured by looking at this spark for more than a moment. In the construction of transformers intended to be used in this manner, very special precautions have to be taken in the insulation of the primary and secondary circuits, and the insulation of these from the core.

It may be remarked in passing that experimenting with large high tension transformers coupled to condensers of large capacity, is extremely dangerous work, and the greatest precaution is necessary to avoid accident. In the light, however, of sufficient experience there is no difficulty in employing high tension transformers in the above described manner, and in obtaining electromotive forces of upwards of a hundred thousand volts, supplied through transformers capable of yielding any required amount of current.

In occasions where continuous current alone is available, a motor generator has to be employed converting the continuous current into alternating current. This is best achieved by the employment of a small alternator direct coupled to a continuous current motor; or by providing the shaft of a continuous current motor with two rings connected to two opposite portions of its armature, so that when continuous current is supplied to the brushes pressing against the commutator, an alternating current can be drawn off from two other brushes touching the above-mentioned insulated rings.

The next element of importance in the transmitting arrangement is the spark gap. In the case of those transmitters employing an ordinary induction coil, the secondary spark, or the discharge of any condenser connected to the secondary terminals, can be taken between brass balls about half an inch or one inch in diameter, with which the terminals of the secondary coil are usually furnished, and it is generally the custom to allow this spark discharge to take place in air at ordinary pressures. In the early days of his work, Mr. Marconi adopted the discharger devised by Professor Rhigi, in which the spark takes place between two brass balls placed in vaseline or other highly insulating oil.* But whatever advantages may accrue from using oil as the dielectric in which the spark discharge takes place, when carrying out simple laboratory experiments on Hertzian waves,

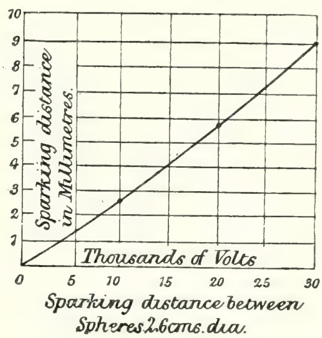
* It has sometimes been stated that the spark balls must be *solid*, and not hollow, but this is a fallacy, and has been disproved by Mr. C. A. Chant. See "An Experimental Investigation into the skin effect in Electrical Oscillators," *Phil. Mag.*, vol. 3. ser. 6. p. 425, 1902.

here is no advantage in the case of wireless elegraphy. If discharges having large uantity are passed through oil, it is rapidly lecomposed and charred, and ceases to retain he special insulating and self-restoring haracter which is necessary in the medium n which an oscillating spark is formed. The onditions when the discharges of large conlensers are passed between spark balls are ntirely different from those when the quantity of the spark, or to put it in more exact anguage, the current passing, is very small. In the case of Hertzian experiments it is necessary, as is shown by Hertz, to mainain a high state of polish on the spark balls when they are employed for the proluction of short waves of small energy, but when we are dealing with large quantities of energy at each discharge those methods which succeed for laboratory experiments are perfectly impracticable. The conditions neessary to be fulfilled by a discharger for use n Hertzian wave telegraphy, are that the surfaces shall maintain a constant condition, and not be fused or eaten away by the spark; and next, that the medium in which the discharge takes place shall not be decomposed by the passage of the spark, but shall maintain the property of giving way suddenly when a certain critical pressure is reached, and passing instantly from a condition in which it is a very perfect insulator to one in which it is a very good conductor, and thirdly, that on the cessation of the discharge, the medium shall immediately restore itself to its original condition.

When using the ordinary 10-inch induction coil, and when the capacity charged by it does not exceed a small fraction of a microfarad, it is quite sufficient to employ brass or steel balls separated by a certain distance in air at the ordinary pressure, as the arrangement of the discharger. When, however, we come to deal with the discharges of very large condensers at high electromotive forces, then it is necessary to have special arrangements to prevent the destruction of the surfaces between which the spark passes or their continual alteration, and many devices have been invented for this purpose. I have myself devised an arrangement which fulfils the above conditions very perfectly, for use in large power stations, but the details of this cannot be made public at the present time.

We have to consider in connection with this part of the subject, the dielectric strength of air under different pressures and for different thicknesses. It is well known, as is shown by Lord Kelvin in 1860, that the dielectric strength of very thin layers of air is greater than that of thick layers.* The electric force, reckoned in volts per centimeter, required to pierce a thickness of air from two to ten millimeters in thickness at atmospheric pressure, may be taken at 30,000 volts per centimeter. The same force in electrostatic units is represented by the number 100, since a gradient of 300 volts per centimeter corresponds to a force of one electrostatic unit. It appears also that for air and other gases there is a certain minimum voltage (approximately 400 volts) below which no discharge takes place, however near the conducting surfaces may be approximated. In this particular practical application, however, we are only concerned with spark lengths which are measured in millimeters

Fig. 29.



or centimeters, lying say between one or two millimeters and five or six centimeters. Over air pressure is increased above the normal by including the spark balls in a vessel in which air can be compressed, then the spark length corresponding to a given potential difference very rapidly decreases. Mr. F. J. Jervis-Smith† found that by increasthis range of spark length we shall not generally be wrong in reckoning the voltage required to produce a spark between metal balls in air at the ordinary pressure to be given by the rule: — *Disruptive voltage* = 3000 × *spark gap length in millimeters.* The relation between spark length and

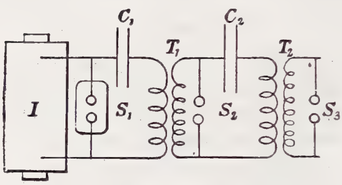
* See "Proc: Roy: Soc: Lond:" Feb. 23rd and April 12th, 1860; or Reprint of Papers on Electrostatics and Magnetism, p. 247.

† See *Phil. Mag*, August, 1902, vol. 4, p. 224, sixth series. Mr. Jervis-Smith has also described an experiment to show how much the use of compressed air round a spark gap is of advantage in working an ordinary Tesla coil. Mr. Marconi had long previously mentioned the use of compressed air round the spark gap.

voltage under these conditions is shown by the line* in Fig. 29. If, however, the ing the air pressure from one atmosphere to two atmospheres, round a pair of spark balls, he reduced the spark length given by a certain voltage from 2·5 cms. to 0·75 cm.

Professor R. Fessenden has also made some interesting observations on the effect of using compressed air round spark gaps. He found that if a certain voltage between metal surfaces would yield a spark four inches in length, at the ordinary pressure of the air, if the spark balls were enclosed in a cylinder, and the air round them compressed at 50 pounds per square inch, the spark length for the same potential difference of the balls was only one-quarter of an inch, or one-sixteenth of its former value.

FIG. 30.



Multiple Oscillation Transformation.

I have myself also made experiments with an apparatus I have designed, which is on the table before me, on the effect of compressed air round the spark gap. The experimental arrangements are as follows:—A 10-inch induction coil has one of its terminals connected to the internal coating of a battery of Leyden jars. The external coating is connected through the primary coil of an oscillation transformer with the other secondary terminal of the coil, and these secondary terminals are also connected to a spark gap consisting of two brass balls enclosed in a glass vessel into which air can be forced by a pump, the air pressure being measured by a gauge. The balls in the glass vessel are set at a distance of about three millimeters apart. The secondary circuit of the oscillation transformer is connected to another pair of spark balls, the distance of which can be varied (see Fig. 30).

Suppose we begin with the air in the glass vessel containing the balls connected to the secondary terminals of the induction coil, which I will call the secondary balls, at atmospheric pressure, and create oscillatory discharges in the primary coil of the oscillation transformer, we have a spark between the balls which I will call the tertiary balls, connected to the secondary terminals of the oscillation transformer. In the experiment, as now shown, if the secondary balls are placed three millimeters apart, and the air in the glass vessel enclosing them is at the ordinary atmospheric pressure, then with the particular arrangement of jars now used, we have a spark 25 or 26 millimeters long between the tertiary balls. Suppose, then, we increase the pressure of the air round the secondary balls pumping it up by degrees to 10, 20, 30, 40 and 50 pounds per square inch above the atmospheric pressure. We find that the spark between the tertiary balls will gradually leap a greater and greater distance, and when the pressure of the air is 50 pounds per square inch we can obtain a 50 millimeter spark between the tertiary balls, whereas, when the air in the glass vessel is at atmospheric pressure, we can only obtain a spark between the tertiary balls of half that length.

This experiment shows us that the effect of compressing the air round the secondary terminals of the induction coil is to greatly increase the difference of potential between these balls before the spark passes. In fact it requires about double the voltage to force a spark of the same length through air compressed at 50 pounds on the square inch than it does to make a spark of identical length between the same balls in air at normal pressure. This shows that there is a very great advantage in taking the discharge spark in compressed air. A better effect can be produced by substituting dry gaseous hydrochloric acid for air at ordinary pressures.

One other incidental advantage is that the noise of the spark is very much reduced. The continual crackle of the discharge spark of the induction coil in connection with wireless telegraphy is very annoying to sensitive ears, but in this manner I can render it perfectly silent.

Professor Fessenden also states that when the spark balls are surrounded by compressed air, and if one of the balls is connected with a radiator, the compression of the air, although it shortens the spark gap corresponding to a given voltage, does not in any way increase the radiation. When, however, the air in the spark ball vessel is compressed to 60 pounds in the square inch, there is a marked increase in the effective radiation, and at 80 pounds per square inch the energy emitted in the form of waves is nearly three and a half times greater than at 50 pounds, the potential difference between the balls remaining the same.

This effect is no doubt connected with the fact that the production of a wave, whether in æther or in any other material, is not so much dependent upon the absolute force applied, as upon the suddenness of its application. To translate it into the language of the electronic theory, we may say that the electron radiates only whilst it is being accelerated, and that its radiating power therefore depends not so much upon its motion as upon the rate at which its motion is changing.

The advantage in using compressed air round the spark gap, is that we can increase the effective potential difference between the balls without rendering the spark non-oscillatory. In air of the ordinary pressure, there is a certain well-defined limit of spark-length for each voltage, beyond which the discharge becomes non-oscillatory, but by the employment of spark balls in compressed air, we can increase the potential difference between the balls corresponding to a given distance apart, before a discharge takes place, or employ higher potentials with the same length of spark gap. In addition to this we have, perhaps, production of a more effective radiation, as asserted by Fessenden, when the air pressure exceeds a certain critical value.

The next element which we have to consider in the transmitting arrangements, is a condenser of some kind for storing the energy which is radiated at intervals. Where a condenser other than the aerial is employed for storing the electric energy which is to be radiated by the aerial, some form of it must be constructed which will withstand high potentials. As the dielectric for such a condenser, only two materials seem to be of any practical use, viz., glass and micanite. Glass condensers in the form of Leyden jars have been extensively employed, but they have the disadvantage that they are very bulky in proportion to their electrical capacity. The instrument maker's quart Leyden jar has a capacity of about five-hundredth of a microfarad, but it occupies about 150 cubic inches or more. Professor Braun has employed in his transmitting arrangements condensers consisting of small glass tubes like test tubes, lined on the inside and outside with tinfoil, which are more economical in space. I have, however, found that condensers for this purpose are best made of sheet-glass about one-eighth or one-tenth of an inch in thickness, coated to within one inch of their edge on both sides with tinfoil, and arranged in a vessel containing resin or linseed oil, like the plates of a storage battery. M. D'Arsonval has employed micanite, but although this material has a considerably higher dielectric strength than glass, it is much more expensive to obtain a given capacity by means of micanite than by glass, although the bulk of the condenser for a given capacity is less.

To store up a certain amount of electric energy in a condenser we require a certain definite volume of dielectric, no matter how we may arrange it, and the volume required per unit of energy is determined by the dielectric strength of the material. Thus, for instance, I find that ordinary sheet glass cannot be safely employed with a greater electric force than is represented by 20,000 volts, for one-tenth of an inch in thickness, or say a potential gradient of 160,000 volts per centimeter. This is equivalent to an electric force of about 500 electrostatic units. This may be called the safe working force. The electrostatic capacity of a condenser formed of two metal surfaces a foot square separated by glass three millimeters in thickness, is between 1-360th and 1-400th of a microfarad. If this condenser is charged to 20,000 volts, we have stored up in it half a joule of electric energy, and the volume of the dielectric is 270 cubic centimeters. Hence to store up in a glass condenser electric energy represented by one joule at a pressure of 20,000 volts, we require 500 cubic centimeters of glass, and it will be found that if we double the pressure and double the thickness of the glass, we still require the same volume.* Hence in the construction of high tension condensers to store up a given amount of energy, the economical problem is how to obtain the greatest energy-storing capacity for the least money. As far as my own experience goes, glass fulfils this condition better than any other material. I have found that although some materials may have very high dielectric strength, such as paper saturated with various oils, or resins, yet they cannot be used for the purpose of making condensers to yield oscillatory discharges, because the oscillations are damped out of existence too soon by the dielectric.

In arranging condensers to attain a given capacity, regard has to be taken of the fact that for a given potential difference there must be a certain total thickness of dielectric, and

* This energy storage is at the rate of 44 foot-pounds per cubic foot of glass. This figure shows what a relatively small amount of energy is capable of being stored up in the form of electric strain in glass. In the case of an air condenser it is only stored at the rate of one foot-pound per cubic foot.

that if condensers of equal size are being arranged in parallel, it adds to their capacity, whilst joining them in series divides their capacity. If N equal condensers or Leyden jars have each a capacity represented by C, and if they are joined n in series, and m in parallel, the joint capacity of the whole number is m C/n, where the product $m\ n = N$.

Passing on next to the consideration of oscillation transformers of various kinds. These are appliances of the nature of induction coils for transforming the current or electromotive force of electrical oscillations in a required ratio. The term oscillation transformer is a better term to apply to them than the usual denomination of Tesla coil, because Mr. Tesla was not by any means the first to transform oscillations by means of an air core induction coil. These coils are of course destitute of any iron core, and they generally consist of coils of wire wound on a fibre, wooden or ebonite frame, and they must be immersed in a vat of oil to preserve the necessary insulation. No dry insulation of the nature of indiarubber or guttapercha will withstand the high pressures that are brought to bear upon the circuits of an oscillation transformer. In constructing these transformers we have to set on one side all previous notions gathered from the design of low frequency iron core transformers. The chief difficulty we have to contend against in the construction of an effective oscillation transformer is the inductance of the primary circuit and the magnetic leakage that takes place. In other words, the failure of the whole of the flux generated by the primary circuit to pass through or be linked with the secondary circuit. Mr. Marconi has employed a special form of oscillation transformer in the design of which he was guided by a large amount of experience. In this transformer the two circuits are wound round a wooden frame. The primary circuit consists of a number of strands of thick insulated cable laid on in parallel, so that it consists of only one turn of a stranded conductor. The secondary circuit consists of a number of turns, say 10 to 20 turns, of thinner insulated wire laid over the primary circuit, and close to it, so that the transformer has the transformation ratio of 1 to 10, or 1 to 20. In the arrangements devised and patented by Mr. Marconi, these two circuits with their respective capacities in series with them are tuned to one another, so that the time period of each circuit is exactly the same, and unless made in this manner and with this tuning the device becomes ineffective as a transformer* for Hertzian wave creating oscillations. There is no advantage in putting a number of turns on the primary circuit, because such multiplication simply increases the inductance, and therefore diminishes the primary current in the same ratio which it multiplies the turns, and hence the magnetic field due to the primary circuit, remains the same. Where it is desired to put a number of turns upon a coil, and yet at the same time keep the inductance down, I have adopted the device of winding a silk or hemp rope, well paraffined, between the turns of the circuit, so as to keep them further apart from one another, and as the inductance depends on the turns per centimeter, this has the effect of reducing the inductance.

The next and most important element in any transmitting station is the aerial or radiator, and it was the introduction of this element by Mr. Marconi at both the transmitting and receiving stations, when used in connection with electric wave devices, which laid the foundation for Hertzian wave telegraphy as opposed to mere experiments with the Hertzian waves. We may consider the different varieties of aerial which have been evolved from the fundamental idea. The simple single Marconi aerial consists of a bare or insulated wire, generally about 100 or 150 feet in length, suspended from a sprit attached to a tall mast. As these masts have generally to be erected in exposed positions, considerable care has to be taken in erecting them with a large margin of strength. To the end of a sprit is attached an insulator of some kind, which may be a simple ebonite rod, or, sometimes, a more elaborate arrangement of oil insulators, and to the lower end of of this insulator is attached the aerial wire. As at the top of the aerial we have to deal with potentials capable sometimes of giving sparks several feet in length, the insulation of the upper end of the aerial is an important matter.

In the original Marconi system, the lower end of the aerial was simply attached to one spark ball connected to one terminal of the induction coil, and the other terminal and spark ball were connected to the earth. In this arrangement, the aerial acted not only as radiator, but as energy-storing capacity, and as already explained, its radiating power was on that account limited. The earth connection is an important matter. For long distance

* See British Specification, No. 7777, 1900. G. Marconi "Improvements in Apparatus for Wireless Telegraphy."

work, a good earth is essential. This earth must be made by embedding a metal plate in the soil, and many persons are under the impression that the efficiency of the earth plate depends upon its area, but this is not the fact. It depends much more upon its shape, and principally upon the amount of its "edge." It has been shown by Professor A. Tanakadate, of Japan, that if a metal plate of negligible resistance is imbedded in an infinite medium, having a resistivity r, the electrical conductance of this plate is equal to $4\ \pi/r$ times the electrostatic capacity of the same plate placed in a dielectric of infinite extent. Hence, in designing an earth plate we have to consider, not how to give it the utmost amount of surface, but how to give it the greatest electrostatic capacity, and for this purpose it is far better to divide a given amount of metal into long strips radiating out in different directions, rather than to employ it in the form of one big square or circular plate. The importance of the "good earth" will have been seen from our discussion in the previous lecture on the mode of formation of electric waves. There must be a perfectly free access for the electrons to pass into and out of the aerial. Hence if the soil is dry or badly conductive in the neighbourhood, we have to go down to a level at which we get a good moist earth. In fact, the precautions which have to be taken in making a good earth for Hertzian wave telegraphy are exactly those which should be taken in making a good earth for a lightning conductor.

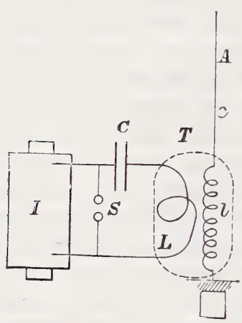
Whilst on the subject of aerials, a word may be said on the localisation of wireless telegraph stations on the Marconi system. For reasons which were explained in the first lecture, the transmission of signals is effected more easily over water than over dry land, and it is hindered if the soil in the neighbourhood of the sending station is a poor conductor. Hence all active Hertzian wave telegraph stations, like all active volcanoes, are generally found near the sea. In those cases in which a multiple aerial has to be put up, consisting of many wires, then one mast may be insufficient to support the structure, and several masts arranged in the form of a square or a circle have to be employed. The illustrated papers have reproduced numerous pictures of the Marconi power stations at Poldhu, in Cornwall, and Glace Bay in Nova Scotia, and Cape Cod in America. In these stations, after preliminary failures to obtain the necessary structural strength with ordinary masts, tall lattice girder wooden towers have been built, about 215 feet in height, well stayed against wind pressure, and which so far have proved themselves capable of withstanding any storm of wind which has come against them.

An important question in connection with the sending power of an aerial, is that of the relation of its height to the distance covered. Some time ago, Mr. Marconi enunciated a law as the result of his experiments, connecting these two quantities, which may be called Marconi's law. He stated that the height of the aerial to cover a given distance, other things remaining the same, varies as the square root of the distance. Let D be the distance, and let L be the length of the aerial; then if both the transmitting and receiving aerial are the same height, we may say that D varies as L^2. This relation may be theoretically deduced as follows: Any given receiving apparatus for Hertzian wave telegraphy requires a certain minimum energy to be imparted to it to make it yield a signal. If the resistance and the capacity of the receiver is taken as constant, this minimum working energy is proportional to the square of the electromotive force set up in the receiving aerial by the impact on it of the electric waves. This electromotive force varies as the length of the receiving aerial, and as the magnetic force due to the wave cutting across it, and the magnetic force varies as the current in the transmitting aerial, and therefore for any given voltage, varies as the capacity, and therefore as the length of the transmitting aerial. If, therefore, the transmitting and receiving aerial have the same length, the minimum energy varies as the square of the electromotive force in the receiving aerial, and therefore as the fourth power of the length of either aerial, since the electromotive force varies as the product of the lengths of the aerials. Hence when the distance between the aerials is constant, the minimum working energy varies as the fourth power of the height of either aerial, but when the lengths of the aerials are constant, the energy caught up by the receiving aerial must vary inversely as the square of the distance D between the aerials. Hence if we call e this minimum working energy, e must vary as $1/D^2$ when L is constant, or as L^4 when D is constant, and since e is a constant quantity for any given arrangements of receiver and transmitter, it follows that when the height of aerial and distance vary, the ratio L^4/D^2 is constant, or in other words, D^2

varies as L^4, or D varies as L^2, that is, distance varies as the square of the height of the aerial, which is Marconi's law. The curve, therefore, connecting height of aerial with sending distance, for given arrangements, is a portion of a parabola, and such a curve shows the sending distance in relation to height of aerial for any particular appliance. Otherwise the law may be stated in the form $L = \alpha\sqrt{D}$, where α is a coefficient. If L and D are both measured in meters, then, for recent Marconi apparatus, as used on ships, $\alpha = 0{\cdot}15$ roughly. (See a Report, on experiments made for the Italian Navy, 1900-1901, by Captain Quintino Bonomo: "Telegrafia Senza Fili," Rome, 1902.)

This law, however, must not be applied without discretion. After Mr. Marconi had transmitted signals across the British Channel, some people, forgetting that a little knowledge

FIG. 31.

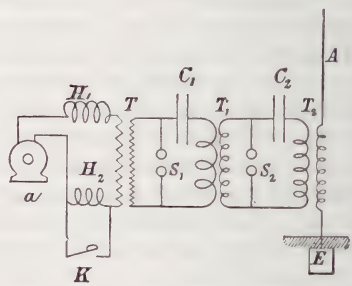


AERIAL, WITH OSCILLATION TRANSFORMER FOR TRANSMITTING.

is a dangerous thing, predicted that an aerial a thousand feet in height would be required to get across the Atlantic, but Mr. Marconi has made such improvements of late years in the receiving arrangements that he has been able to receive signals over 3,000 miles in 1903, with aerials only 33 per cent. longer than those which, in 1899, he employed to cover 20 miles across the British Channel.

We turn, in the next place, to the consideration of those devices for putting more power into the aerial than can be achieved when the aerial itself is simply employed as the reservoir of energy. Professor Braun, of Strasburg, in 1899, described an inductive method for producing oscillations in the aerial by means of an oscillation transformer, these oscillations being set up by the discharges from a Leyden jar or battery of Leyden jars, which formed the reservoir of energy. The induction coil is employed to produce a rapidly intermittent series of electrical oscillations in the primary coil of an oscillation transformer by the discharges of a Leyden jar. Mr. Marconi made a great advance on this arrangement, as described by him in a lecture given before the Society of Arts, on May 17th, 1901*, by syntonising the two circuits and making the circuit consisting of the capacity of the aerial and the inductance of the secondary circuit of the oscillation transformer, have the same time period as the circuit consisting of the Leyden jars or energy-storing condenser and the primary circuit of the oscillation transformer, and by so doing, immensely added to the power and range of the apparatus. (See Fig. 31.) Starting from these inventions of Braun and Marconi, I have myself devised a double transformation arrangement in which the oscillations are twice transformed before being generated in the aerial, each

FIG. 32.



time with a multiplication of electromotive force, and a multiplication of the number of groups of oscillations per second. This arrangement can best be understood from the diagram (see Fig. 32). In this case, a transformer or transformers receive alternating low frequency current from an alternator, being regulated by passing through variable choking coils so as to control it. This alternating current is transformed up from a potential of 2,000 to 20, 40, or 100,000 and is employed to charge a large condenser which discharges across a primary spark gap through the primary coil of an oscillation transformer. The secondary circuit of the oscillation transformer is connected to a second pair of spark balls which in turn are connected by a secondary condenser, and the primary circuit of a third transformer, and the secondary circuit of this last transformer is inserted in between a Marconi aerial and the

* See *Journal of the Society of Arts*, vol. xlix, p. 506.

earth. When all these circuits are tuned to resonance by Mr. Marconi's methods, we have a very powerful arrangement for creating electric waves, or rather, trains of electric waves sent out from the aerial, and the oscillations are controlled and the signals made by short-circuiting one of the choking coils.

Another transmitting arrangement which involves a slightly different principle, and employs no oscillation transformer, is one which I believe is due also to Professor Braun. In this case a condenser and inductance are connected in series to the spark balls of an induction coil, and oscillations are set up in this circuit. Accordingly, there are rapid fluctuations of potential at one terminal of the condenser. If to this we connect a long aerial, the length of which has been adjusted to be one quarter of the length of wave corresponding to the frequency, in other words, to make it a quarter wave resonator, then powerful oscillations will be accumulated in this rod. The relation between the height (H) of the aerial and the frequency is given by the equation: $3 \times 10^{10} = 4\, n\, H$, where n is the frequency of the oscillations and H the height of the aerial in centimeters. The frequency of the oscillations is determined by the capacity (C) and inductance (L) of the condenser circuit, and can be calculated from the formula:—

$$n = \frac{5{,}000{,}000}{\sqrt{C \text{ (in mfds.)} \times L \text{ (in cms.)}}}$$

That is, the frequency is obtained by dividing into the number 5,000,000 the square root of the product of the capacity in microfarads and inductance in centimeters, of the condenser circuit. It will be found, on applying these rules, that it is impossible to unite together any aerial of a length obtainable in practice, with a condenser circuit of more than a very moderate capacity. It has been shown in the first lecture that for an aerial 200 feet in height, the corresponding resonating frequency is about one and a quarter million.* As we are limited in the amount to which we can reduce the inductance of a discharge circuit, probably to something like a thousand centimètres, a simple calculation shows that the largest capacity we can employ is about a sixtieth of a microfarad. This capacity even if charged at 60,000 volts, would only contain 30 joules of energy, or about $22\frac{1}{2}$ foot-pounds, which is a small storage compared to that which can be achieved when we are employing the above described methods, which involve the use of an oscillation transformer. In such a case, however, it is an advantage to employ a spark gap in compressed air, because we can then raise the voltage to a much higher value than in air at ordinary pressure, without lengthening the spark so much as to render it non-oscillatory.

When employing methods involving the use of an oscillation transformer, it is possible to use multiple aerials having large capacity, and hence to store up a very large amount of energy in the aerial, which is liberated at each discharge. The most effective arrangement is one in which the radiator draws off gradually a large supply of energy from a non-radiating circuit, and so sends out a true train of waves, and not mere impulses, into the æther; and, as we shall see in the last lecture, it is only when the radiation takes place in the form of true wave trains that anything like syntony can be obtained.

There are a number of variants of the above methods of arranging the radiator and associated energy-storing in circuit, amongst these may be noticed some by Professor Slaby and Count von Arco. In one of these the aeria is connected to the earth plate through an openly wound inductance coil, and one of a pair of spark balls is connected to this aerial just above the coil. The other ball is joined to a wave equal in length to the aerial coiled in a loose spiral. The secondary terminals of an induction coil are connected to the two spark balls. The arrangement labours under the disadvantage of the simple Marconi aerial, that it has a small energy-storing capacity.

Another arrangement of Professor Slaby is as follows:—A pair of spark balls are connected through a primary condenser and an inductance coil, one side of the inductance coil being earthed, and the other connected by a long insulated wire with an openly wound coil, which terminates on an insulated aerial. The lower end of this aerial is provided with a spark ball facing another spark ball connected to the earth. The arrangement works out in the following manner:—When the primary condenser is charged and discharged across a spark gap, oscillations are set up in the circuit containing

* That this number really does represent the order of the oscillation frequency in an aerial, has been shown by C. Tissot, *Comptes Rendus* 132, p. 763, March 25th, 1901, by photographs taken of the oscillatory spark of a Hertzian wave telegraph transmitter. (See *Science Abstracts*, vol. iv., abs. 1518). He found frequencies from 0·5 million to 1·6 million.

that condenser, and its associated inductance, and hence oscillations are propagated into the openly wound coil. This last coil, Professor Slaby calls a *multiplicator*, because the tension at its outer end is much larger than the tension at the end where it is connected to the oscillating circuit. It acts in this manner because its length is adjusted so as to resonate with the frequency of the condenser circuit. Thus, the simple Marconi aerial has, as it were, applied to its upper spark ball a potential which is considerably greater than that which could be obtained by applying the terminals of the induction coil directly to it. In the case of ship work, the aerial and multiplicator can be placed in the outer air, whilst the condenser circuit can be in the cabin below deck. The connection between the multiplicator and condenser circuit being made by an insulated wire passing through an insulated tube. This arrangement has the advantage that the aerial has a large store of energy to draw upon, and hence its oscillations are far less quickly damped than in the case of the simple Marconi aerial. A large number of patents have been taken out by Professor Slaby and those associated with him for various forms of aerial associated with condensers in various ways. In one case, a simple or multiple aerial is connected at the top to an earth wire running parallel with it, which is coiled so as to have a high inductance. The bottom of the aerial terminates on one plate of a condenser, the other plate of which is connected to a spark ball, the fellow spark ball being connected to the earth. If then the spark balls are connected to a high tension transformer or induction coil, we have a series of oscillations set up in the aerial which necessarily have a current node at the top of the simple or multiple aerial. In this arrangement, the aerial is earthed as far as regards slow oscillations, and hence the condenser can become charged, but, when the spark takes place, the oscillations are not propagated down the inductive earth wire fromthe top of the aerial, but that portion of the aerial above the condenser acts as a radiator.

Miscellaneous.

COTTON GROWING IN GERMAN WEST AND EAST AFRICA.

Considerable confidence is expressed in Germany as to the results of the experiments which have for the last two years been made with cotton growing in Togoland and German East Africa. The conditions of the soil and climate in Togoland are, it is believed, favourable to the growth of cotton, and the natives, by whom it has long been cultivated in many parts of the country, have shown considerable readiness and intelligence as regards the adoption of American methods of cultivation. Experimental stations have been started at Tove and other places, under the supervision of American experts, and the cotton is brought down to Lome on mules and oxen, previously inoculated with Dr. Schilling's anti "surrah" serum, which H.M. Secretary of Embassy at Berlin says has been found very efficacious as a preventative of that disease. Some 108,000 lbs. of cotton, grown during the year 1901-2 from native (Togoland), American, and Egyptian seed, were shipped to Bremen, where, on examination by experts, that produced from native seed was pronounced as slightly superior to, and that from American seed slightly inferior to, "middling American." The Egyptian seed cotton came last in their estimation. Experiments are now being made to produce it, by crossing a variety combining the qualities of both the native and the American cotton plant. The reports sent home as to the existence of wild cotton in many parts of the districts between the coast of the East African Protectorate and the Great Lakes, induced the Colonial Economic Committee, in June, 1901, to institute similar experiments in that colony. The delta of the Rufiji and the Kilwa district are said to offer the best promises of success, and experiments have already been made in the latter region with Egyptian, American, and Indian seeds. The first of these three seeds appears to have furnished the best results, and the samples of cotton sent to Germany have been classed by the Bremen Cotton Exchange as on a par with Egyptian cotton. An expert has recently been sent from East Africa to study cotton growing in the United States, and to select a staff of cotton planters to work under him on his return to the colony.

Obituary.

BARON WILLIAM DE BUSH.—Baron de Bush, a member of the Society of Arts since 1888, died at Northampton on Friday, 24th inst., from injuries caused by falling, on Thursday evening, from a London and North Western express train travelling at full speed between Blisworth and Rugby. Baron de Bush was born on the 29th October, 1860, the son of the late William John Bush, manufacturing chemist. He was connected with several of the International Exhibitions as British Juror (Chemicals), Antwerp, 1885; President Chemical Section, Brussels. 1888; Chairman British Jurors, Edinburgh, 1890; and President Chemical Jury, Brussels, 1897. He was created a Baron of the Duchy of Saxe Coburg in 1889, and received Royal license to use the title in this country in 1896.

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Proceedings of the Society.

CANTOR LECTURES.

HERTZIAN WAVE TELEGRAPHY.*

By Dr. J. A. Fleming, F.R.S.

Lecture III.—Delivered March 16th, 1903.

Receiving Arrangements and Receivers.

We have to consider in the next place the arrangements of the receiving station, and the various forms of receivers that have been devised for effecting telegraphy by Hertzian waves. Just as the transmitting station consists essentially of two parts, viz., a part for creating electrical oscillations and a part for throwing out or radiating electric waves, so the receiving station appliances may be divided into two portions, the function of one being to catch up a portion of the energy of the passing wave, and that of the other to make a record or intelligible signal in some manner in the form of an audible or visible sign.

Accordingly, there must be at the receiving station an arrangement called a receiving aerial, which in general takes the form of a long vertical wire or wires similar in form to the transmitting aerial. There is, however, a distinct difference in the function of the transmitting aerial and the receiving aerial. The functions of the first is effective radiation, and for this purpose the aerial must have associated with it a store of energy to be released as wave energy, but the function of the receiving aerial is to be the seat of an electromotive force which is created by the electric force, and the magnetic force of the incident electric wave.

* The blocks illustrating these lectures have been kindly lent by the Proprietors of *Engineering*.

I may remind you once again that in tracing out the mode of operation of the transmitting aerial, it was pointed out that the electric waves emitted consisted of alternations of electric force in a direction which is perpendicular to the surface of the earth, and magnetic force parallel to the surface of the earth. These two quantities, the electric force and the magnetic force, are called the *wave vectors*, and they both lie in a plane perpendicular to the direction in which the wave is travelling, and at right-angles to one another, the electric force being perpendicular to the surface of the earth. In optical language, the wave sent out by the aerial would be called a plane polarised wave, the plane of polarisation being parallel to the magnetic force. Hence, if at any point in the path of the wave we erect a vertical conductor, as the wave passes over it, it is cut transversely by the magnetic force of the wave, and longitudinally by the electric force. Both of these operations result in the creation of an alternating electromotive force in the receiving aerial wire. The function of this wire therefore is, as suggested by the author in a discussion on this subject some years ago,* to integrate the electric force into electromotive force, and the electromotive force set up in the aerial is therefore proportional to its height, other things being equal, and for a given height is proportional to the amplitude of the electric wave. If, therefore, we have an insulated or uninsulated vertical wire placed in the path of the wave, as described, an alternating electromotive force is set up in it, the frequency of which depends upon the wave length of the wave.

Just as in all other cases of oscillatory motion, the principle of resonance may here be brought into play to immensely increase the amplitude of the current oscillations thereby set up in the receiving aerial. As already explained, any vertical insulated wire placed with its lower end near the earth, has capacity with respect to the earth, and it has also inductance, the value of this factor depending on its shape and height. Accordingly, it has a natural electrical time period of its own, and if the periodic electromotive impulses which are set up in it by the passage of the waves over it, agree in period with its own natural time-period, then the amplitude of the current vibrations in it may become

* See "Journal of Inst. of Elec. Engineers," vol. 27, 1898, p. 901. Remarks by J. A. Fleming in a discussion on a paper by Sir Oliver Lodge on "Magnetic Space Telegraphy."

enormously greater than when there is a disagreement between these two periods. In the next lecture we shall return to this subject of electric resonance and syntony, and discuss it with reference to what is called the tuning of Hertzian wave stations. Meanwhile, it may be said that for the sake of obtaining, at any rate in an approximate degree, this coincidence of time period, it is generally usual to make the receiving aerial, as far as possible, identical with the transmitting aerial. If the receiving aerial is not insulated, but is connected to the earth at its lower end, through the primary coil of an oscillation transformer, we can still set up in this earthed receiving aerial oscillations, by the impact on it of an electric wave of proper period, and if the oscillation transformer is properly constructed, we can draw from its secondary circuit electric oscillations in a similar period.

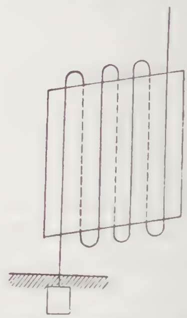
One problem in connection with the design of a receiving aerial is that of increasing its effective length and capacity, so as to make it the seat of electromotive force or current oscillations of the greatest amplitude. It is clear that if we put a number of receiving wires in parallel, so that each one of them is operated upon by the wave separately, although we can increase in this way the magnitude of the alternating current, which can be drawn off from the aerial, we cannot increase the electromotive force in it except by increasing the height of the wires. It is obvious that it is not easy to multiply the effect of aerials, or, as it were, to add them in series to one another. Attempts have been made to do this by winding a long wire round a metal plate, so as to shield one half of the wire from the impact of the wave, and thus add together the electromotive force in the straight windings of the wire, just as the electromotive force set up in the different bars of a dynamo armature are added together to produce the resultant electromotive, but no devices of this kind, as far as the author is aware, have been successful.* (See Fig. 33.) The presence of any conducting plate near an aerial or vertical wire parallel to it, induces interference effects which have the result of nullifying any advantage gained by the multiplication of the wire. Unfortunately, there is a limit to the height of the receiving aerial. It has to be suspended, like the transmitting aerial, from a mast or tower, and the engineering problems of constructing such a permanent supporting structure higher than, say, 200 feet, are very serious.

* See British Patent Specification, No. 12,420 of 1899, granted to F. Braun.

Since any one station has to send as well as receive, it is usual to make one and the same aerial wire or wires do double duty. It is switched over from the transmitting to the receiving apparatus, as required. This, however, is a concession to convenience and cost. In some respects, it would be better to have two separate aerials at each station, the one of the best form for sending, and the other of the best form for receiving.

I shall defer until the next lecture, the consideration of Mr. Marconi's experiments on the use of one aerial to receive two or more independent sets of signals.

FIG. 33.



BRAUN'S RECEIVING AERIAL.

In Mr. Marconi's early arrangements the so-called coherer or sensitive wave-detecting appliance, to be described more in detail presently, was inserted between the base of the insulated receiving aerial and the earth, but it was subsequently found by him to be a great improvement to act upon the receiving appliance not directly, by the electromotive force set up in the aerial, but by the induced electromotive force of a special form of step-up oscillation transformer he calls a "jigger," the primary circuit of which was inserted in between the receiving aerial and the earth plate, and the secondary circuit was connected to the sensitive organ of the telegraphic receiving arrangements.* A suggestion to

* The term "jigger" is one of those slang terms which contrive to effect a permanent attachment to various arts and crafts. Similarly, the word "booster" is now used for a step-up or voltage raising transformer or dynamo inserted in series with an electric supply main. The word "boost" signifies, in American slang, to raise or lift up. "To give a real good boost" is an Americanism for lending a helping hand. The term "jigger" in the same manner is an adaptation of a seaman's term for a hoisting tackle or lift.

employ transformed oscillations in affecting a coherer, had also been made by Sir Oliver Lodge, in 1897, but the essence of success in the use of this device is not merely the employment of a transformer, but of a transformer constructed specially to transform electrical oscillations.

We shall return to the consideration of the details of this appliance later on.

Meanwhile, it will be well to give a moment's consideration to the relation existing between the transmitting and receiving aerials. In their simplest form these two things consist of two similar tall rods of metal placed upright, with their feet in good connection with the earth at two places. We may think of them as two identical lightning conductors, well earthed at the bottom, and supported by non-conducting masts or towers. These two vertical rods are in connection with the earth, and therefore with it form, as it were, one conductor. If, as usual, these aerials are separated by the sea, the intermediate portion of this circuit is an electrolyte. The operations which take place when a signal is sent, is as follows:

At the transmitting station we set up in the transmitting aerial electric oscillations, of which the frequency may be of the order of a million, that is, the oscillations as long as they last, are at the rate of a million a second. Each spark discharge at the transmitter results, however, only in the production of a train of a dozen or two oscillations, and these trains succeed each other at a rate depending upon the transmitting arrangements used. Each oscillation in the transmitting aerial is accompanied by the detachment from it of semi-loops of electric strain, as explained in the first lecture. The alternations of electric strain directed perpendicularly to the earth, and of the associated magnetic force parallel to the earth, constitute an electric wave in the æther, just as the alternations of pressure and motion of air molecules constitute an air wave. Associated with these physical actions above ground, there is a propagation through the earth of electric action, which, as I suggested in the first lecture, is a motion or atomic exchange of electrons. Each change or movement of a semi-loop of electric strain above ground, has its equivalent below ground in interatomic exchanges or movements of the electrons, on which the ends of these semi-loops of electric strain terminate. The earth must play, therefore, a very important part in this so-called "wireless telegraphy," and we might almost say the earth does as much as the æther in its production.

The function of the receiving aerial is to bring about a union between these two operations above and below ground. When the electric waves fall upon it, they give rise to electromotive force in the receiving aerial, and therefore produce oscillations in it which, in fact, are electric currents flowing into and out of the receiving aerial. We may say that the transmitting aerial, the receiving aerial, and the earth, form one gigantic Hertz oscillator. In one part of this system, electric oscillations of a certain period are set up by the discharge of a condenser, and are propagated to the other part. In the earth, there is a propagation of electric oscillations, in the space above and between the aerials there is a propagation of electric waves. The receiving aerial *feels* therefore what is happening at the distant aerial, and can be made to record it.*

We have next to consider the question of the wave detecting devices which enable us to appreciate and record the impact of a wave or wave-train against the aerial. At the very outset, I think it will be necessary to ask permission to coin a new word to apply generally to these appliances. You are all probably familiar with the term "coherer," which was applied by Sir Oliver Lodge in the first instance to an electric wave-detecting device of one particular kind, viz., that in which a metal point was lightly pressed against another metal surface, and caused to stick to it when an electric wave fell upon it. As our knowledge increased, it was found that there were many cases in which the effect of the electric radiation was to cause a severance and not a coherence, and hence such clumsy phrases as "anti-coherer" and "self-decohering-coherer" have come into use. Moreover, we have now many kinds of electric wave detectors based on quite different physical principles. At the risk of incurring reprobation for adding to scientific nomenclature, I venture to think that the time has arrived when a simple and inclusive term will be found useful to describe all the devices, whatever their nature, which are employed for detecting the presence of an electric wave. For this purpose I propose the term "kumascope" (from the Greek κῦμα, a wave). The scientific study of waves has already been called kumatology, and in view

* The "earth" itself probably only conducts electrolytically. All such materials as sand, clay, chalk, &c., and surface soils, are fairly good insulators when very dry, but conduct in virtue of moisture present in them.

of our familiarity with such terms as microscope, electroscope, and hygroscope, I do not think there will be any objection to enlarging our vocabulary by calling a wave-detecting appliance a "kumascope." We are then able to look at the subject broadly, and in the first place to classify kumascopes of different kinds. If anyone objects to this term the alternative term "responder," which has come into use in the United States, can be used. The term "receiver" is, I think, too general, as it applies not only to a variety of appliances, but to a variety of persons.*

Entreating, therefore, your permission to use the word I have suggested, we may in the first place classify *kumascopes* according to the principle on which they act. Thus we may have electric, magnetic, thermal, chemical, and physiological operations involved, and finally, we may divide them into those which are self-restoring in the sense that after the passage or action of a wave upon them, they return to their original sensitive condition, and those which are non-restoring and they must be subjected to some treatment to bring them back again to a condition in which they are fit to respond again to the action of a wave. There is a probability that the first kumascope unconsciously employed was a physiological one. You are all familiar with the anecdote of the event which is said to have laid the foundation of galvanism; that the legs of a frog suspended by silver hooks in a room where an electrical machine was being worked, were found to twitch when sparks were taken from the primary conductor, and that this observation induced Galvani to study animal electricity, and subsequently led Volta to those famous researches which finally gave us the electric current.

I venture to suggest that, as far as we know the facts, these effects may have been due to electric waves. The spark drawn from the primary conductor set up electrical oscillations in the wires by which the frogs were suspended, and the twitching of their legs was the response to these oscillations. So far, however, this observation has not been followed out in the construction of any practical physiological responder or kumascope, for use in Hertzian wave telegraphy.

The above instance, however, is not the only one in which an experimental investigation involved the unconscious use of a detector of electric waves. In 1879, the late Professor D. E. Hughes carried out some remarkable experiments, which, if they had been pursued and not discouraged, might have led him to anticipate some results obtained eight years afterwards by Hertz, as well as to lay the foundations of Hertzian wave telegraphy. He undoubtedly discovered that a metallic microphone, consisting of a loose contact of carbon and steel, was sensitive, not only to air waves, but also to electric sparks at a distance, having its resistance reduced by both causes. The record he gave, in 1899, of experiments made twenty years before, in the presence of credible witnesses, leaves no room for doubt that he was then in fact dealing with electric wave effects, and detecting them by the aid of a telephone, and an imperfect contact of the kind afterwards called a coherer.*

We have no space to refer to the whole of the steps of discovery which led up to the various forms of modern electric wave detector. Suffice it to say that the researches of Hertz, in 1887, threw a flood of light upon many previously obscure phenomena, and enabled us to see that an electric spark, and especially an oscillatory spark, creates a disturbance in the æther, which has a resemblance in nature to the expanding ripples produced by a stone hurled into water. Scientific investigation then returned with fresh interest to previously incomprehensible effects, and a new meaning was read into many old experiments. Again and again, it had been noticed that loose metallic contacts, loose aggregations of metallic filings or fragments, had a mysterious way of altering their conductivity, under the action of electric sparks, lightning discharges, or high electromotive forces.

As far back as 1852, Mr. Varley had noticed that masses of powdered metals had a very small conductivity which increased in a remarkable way during thunderstorms,† and in 1866, C. and S. A. Varley patented a device for protecting telegraphic instruments from lightning, which consisted of a small box of powdered carbon, in which were buried two metal points nearly touching, and they stated that "powdered conducting matter offers a great resistance to a current of moderate ten-

* The word *receiver* is applied to a telephone, a telegraphic instrument, the glass bell of an air pump, to part of a steam engine, to the official who superintends winding up a company, and to the recipient of misappropriated property.

* For an epitome of these important experiments of Prof. D. E. Hughes, in 1870, the reader is referred to Fahie's "History of Wireless Telegraphy," p. 296; or to *The Electrician*, vol. 43, p. 40, May 5th, 1899, where an account of them is given by Professor Hughes himself.

† *The Electrician*, vol. 40, p. 86 (Leader).

sion, but offers but little resistance to currents of high tension." *

We then pass over a long interval, and find that the next published account of similar observations was due to Professor T. Calzecchi-Onesti, who described in an Italian journal, *Il Nuovo Cimento* (see vol. 16, p. 58, and vol. 17, p. 38), in 1884 and 1885, his observations on the decrease in resistance of metal powders when the spark from an induction coil was sent through them. † These observations did not attract much attention, until Professor E. Branly, in 1890 and 1891, repeated them on an extended scale, and with great variations, making the important observation that an electric spark at a distance had a similar effect in increasing the conductivity of metallic powders. ‡ Branly, however, noticed that in some cases of conductors in powder, such as the peroxide of lead, or antimony, the effect of the spark was to cause a decrease of conductivity.

To Professor E. Branly belongs the honour of giving to science a new weapon in the shape of a tube containing metallic filings or powder, rather loosely packed between metal plugs, and of showing that when the pressure on the powder was adjusted, such a tube may be a conductor of very high resistance, but that the electrical conductivity is enormously increased if an electric spark was made in its neighbourhood. He also proved that the same effect occurred in the case of two slightly oxidised steel or copper wires laid across one another with light pressure, and that this loose or imperfect contact was extraordinarily sensitive to an electric spark, dropping in resistance from thousands of ohms to a few ohmns when a spark was made many yards away.

It is curious to notice how long some important researches take to become generally known. Branly's work did not attract much attention in England until 1892, when Dr. Dawson Turner described his own repetition of Branly's experiments with the metallic filings tube, at a meeting of the British Association in Edinburgh. In the discussion which followed, Professor George Forbes made an important remark. He asked whether it was possible that the decrease in resistance could be brought about by Hertz waves.*

This question shows that even in 1892, then the idea that the effect of the spark on the Branly tube was really due to Hertzian waves was only just beginning to arise. The following year, however, Mr. W. B. Croft repeated Branly's experiment with copper filings before the Physical Society of London, and entitled his short paper "Electric Radiation on Copper Filings." He showed a tube, containing copper filings loosely held between two copper plugs, and joined in series with a galvanometer and cell. The effect of an electric spark at a distance, in causing increase of conductivity was exhibited, and the return of the tube to its non-conducting state when tapped, was also noticed.†

In the discussion which followed the reading of this paper, Professor Minchin described the effects of electric radiation on his impulsion cells. He followed up this by reading a paper to the Physical Society on November 24th, 1893, on the action of Hertzian radiation on films containing metallic powders, and expressed the opinion that the change in resistance of the Branly tube was due to electric radiation.‡ Thus, at the end of 1893, a few physicists clearly recognised that a new means had been given to us for detecting those invisible æther waves, the chief properties of which Hertz had unravelled with surpassing skill six years before by means of a detector consisting of a ring of wire having a small spark gap in it.

In June, 1894, Sir Oliver Lodge delivered a discourse at the Royal Institution, entitled the "Work of Hertz," and at this lecture use was made of the Branly tube as a Hertz wave detector. The chief object of the lecture was to describe the properties of Hertzian waves and their reflection, absorbtion, and transmission, and many brilliant quasi-optical experiments were exhibited. Although a Branly tube or imperfect metallic contact, then named by him a "coherer," was employed by Sir Oliver Lodge to detect an electric wave generated in another room, there was no

* British Patent Specification. C. and S. A. Varley, No. 865, 1866.

† See also *Journal de Physique*, vol. 5, p. 573, 1886.

‡ See *Comptes Rendus*, vol. 111, p. 785, 1890; vol. 112, p. 112, 1891; or *La Lumière Électrique*, vol. 40, pp. 301, 506, 1891; or *The Electrician*, vol. 27, pp. 221 & 448.

* See *The Electrician*, vol. 29, 1892, pp. 397 and 432.

† Mr. W. B. Croft, "Proc. Phys. Soc." vol. 12, p. 421. Report of meeting on Oct. 27th, 1893.

‡ See Prof. Minchin, "Proc. Phys. Soc.," Nov. 24th, 1893; or *The Electrician*, vol. 22, 1893, p. 123. See also Prof. Minchin, "Phil. Mag." Jan. 1894, vol. 37, p. 90, "On the Action of Electromagnetic Radiation on Films containing Metallic Powders."

mention in this lecture of any use of the instrument for telegraphic purposes.*

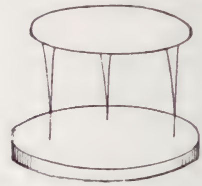
As we are here concerned only with the applications in telegraphy, we shall not spend any more time in discussing the purely scientific work done with the laboratory forms of this wave detector. The classical work of Hertz was all carried out with a responder or kumascope, consisting of a simple resonant circuit with a spark gap in it. We now know that a voltage less than about 400 volts will not create any electric spark at all in air at ordinary pressure, but a Branly filings tube responds to an electromotive force of about two volts on its terminals, as indicated by its transformation from a very high to a very low resistance. We are able to judge by this fact how great an advance the metallic granule kumascope was upon the comparatively insensitive, yet scientific, wave detector with which Hertz accomplished that work which has made his name famous for all time.

Without attempting to touch that very delicate question as to the precise point where laboratory research passed into technical application, we shall briefly describe the forms of kumascope which have been devised with special reference to Hertzian wave telegraphic work. A very exact classification is at present impossible, but we may say that telegraphic kumascopes may be roughly divided into six classes. The first class includes all those that depend for their action on the "coherer principle," or the reduction of the resistance of a metallic microphone by the action of electromotive force. As they depend upon an imperfect contact, they may be called *contact kumascopes*. This class is furthermore subdivided in the self-restoring and non-self-restoring varieties. The second class comprises the *magnetic kumascopes*, which depend upon the action of an electrical oscillation as a magnetising or demagnetising agency. The third-class comprises the *electrolytic responders*, in which the action of electric oscillations either promotes or destroys the results of electrolysis. The fourth class consists of the *electrothermal detectors*, in which the power of an electrical oscillation as a high frequency electric current to heat a conductor is utilised. The fifth class comprises the *electromagnetic* or *electrodynamic* instruments, which are virtually very sensitive alternating current ammeters adapted for immensely high frequency. The sixth class must be made to contain all those which cannot be well fitted at present into any of the others, such as the sensitive responder of Schäfer, the action of which is not very clearly made out.

We may proceed briefly to describe the construction of the principal forms of responder or kumascope coming under the above headings.

In the first place, let us consider those which are commonly called the "coherers," or, as I prefer to call them, the *contact kumascopes*. The simplest of these is the crossed needle or single contact, which originated with Professor E. Branly.* The pressure of the point of a

FIG. 34.



BRANLY TRIPOD COHERER.

steel needle against an aluminium plate was subsequently found by Sir Oliver Lodge to be a very sensitive arrangement when so adjusted that a single cell sends little or no current through the contact†. When an electric wave passes over it, good conducting contact ensues. The point is, in fact, welded to the plate, and can only be detached by giving the plate or needle a slight shock or vibration. A variation of the above form is a pair of crossed needles, one resting on the other.

Professor Branly found in 1891 that if a pair of slightly oxidised copper wires rest across one another, the contact resistance may fall from 8,000 to 7 ohms, by the impact of an electric wave. He has recently devised a tripod arrangement in which a light metal stool with three slightly oxidised legs stand on a polished plate of steel; the contact points must be oxidised, not too heavily, and the stool makes a bad electrical contact until a wave falls upon it‡ (see Fig. 34). The decoherence is effected

* This lecture was afterwards published as a book, the first edition bearing the same title as the lecture, viz., "The Work of Hertz and some of his Successors." In the second edition, published in 1898, an appendix was added (p. 59), containing "The History of the Coherer Principle," and the original title of the work had prefixed to it, "Signalling without Wires."

* See *The Electrician*, vol. 27, p. 222. E. Branly, "Variations of Conductivity under Electrical Influence."

† See *The Electrician*, vol. 40, p. 90. Sir Oliver Lodge, "The History of the Coherer Principle."

‡ See Prof. E. Branly, "A Sensitive Coherer," *Comptes Rendus*, vol. 134, p. 1197, 1902. Or *Science Abstracts*, vol. 5, p. 852, 1902.

by giving the stool a tilt by means of an electromagnet.

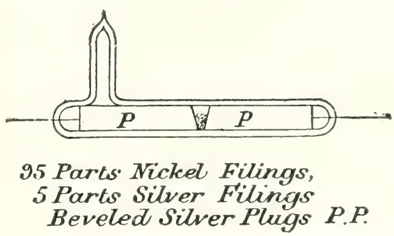
These single or multiple point contact kumascopes labour under the disadvantage that only a very small current can be passed through the variable contact when used as a relay arrangement, without welding them together so much that a considerable mechanical shock is required to break the contact and reset the trap.

The logical development of the single contact is therefore the infinite number of contacts existing in the tube of metallic filings, which has been the form of kumascope most used for many years. In its typical form, it consists of a tube of insulating material with metallic plugs at each end, and between them a mass of metallic powder, filings, borings, granules, or small spheres, lightly touching each other. Imperfect contact must be arranged by light pressure, and in the majority of cases the resistance is very large until an electric wave falls upon the tube, when it drops suddenly to a small value, and remains there until the tube is given a slight shake, or the granules disturbed in any way, when the resistance suddenly rises again. This type of responder is a non-restoring kumascope, and requires the continual operation of some external agency to keep it in a condition in which it is receptive or sensitive to electric waves.

Much discussion and considerable research has taken place in connection with the action and improvement of these metallic powder kumascopes. As regards materials the magnetic metals, nickel, iron, and cobalt, in the order named, appear to give the best results. The noble metals, gold, silver, and platinum, are too sensitive, and the very oxidisable metals too insensitive for telegraphic work, but an admixture may be advantageously made.

Omitting the intermediate developments of invention, it may be said that Mr. Marconi was the first to recognise that to secure great sensibility in an electric wave detector of this type the following conditions must be fulfilled: —An exceedingly small mass of metallic filings must be placed in a very narrow gap between two plugs, the whole being contained in a vessel which is wholly or partly exhausted of its air. Mr. Marconi devoted himself with great success to the development of this instrument, and in a very short time succeeded in transforming it from an uncertain laboratory appliance, capable of yielding results only in very skilled hands, into an instrument certain and simple in its operations as an ordinary telegraphic relay. He did this partly by reducing its size, and partly by a most judicious selection of materials for its construction. As made at present, the Marconi metallic filings tube consists of a small glass tube, the interior diameter of which is not more than one-eighth of an inch, which has in it two silver plugs which are bevelled off obliquely (see Fig. 35). These are placed opposite to each other so as to form a wedge-shaped gap, about a millimeter in width at the bottom, and two, or at most three, millimeters in width at the top. The silver plugs exactly fill the aperture of the tube, and are connected to platinum wires sealed through the glass. The tube has a lateral glass tube fused into it, by which the exhaustion is made, and which is afterwards sealed off, and this

FIG. 35.



MARCONI SENSITIVE TUBE OR KUMASCOPE.

tube projects out on the side of the wide portion of the gap between the silver plugs. The sensitive material consists of a mixture of metallic filings, five per cent. silver, and ninety-five per cent. nickel, being carefully mixed and sifted to a certain standard fineness. In the manufacture of these tubes, great care is taken to make them as far as possible absolutely identical. Each tube when finished, is exhausted, but not to a very high vacuum. The tube so finished is attached to a bone holder, by which it can be held in a horizontal position. The object of bevelling off the plugs in the Marconi tube, is to enable the sensitiveness of the tube to be varied by turning it round, so that the small quantity of filings lie in between a wider or narrower part of the gap.*

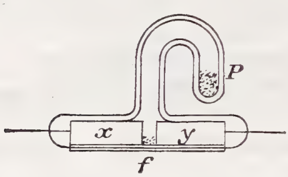
Other ways of adjusting the quantity of the filings to the width of the gap have been devised. Sometimes one of the plugs is made

* This device of making the inter-electrode gap in a tubular filings coherer wedge-shaped, has been patented again and again by various inventors. See German Patent No. 116,113, Class 21a, 1900. It has also been claimed by M. Tissot.

movable. In other cases, such as the tubes devised by M. Blondel and Sir Oliver Lodge, there is a pocket in the glass receptacle to hold spare filings, from which more or less can be shaken into the gap. (See Fig. 36.)

An interesting question which we have not time to discuss in full, is the cause of the initial coherence of the metallic filings in a Branly tube. It does not seem to be a simple welding action due to heat, and it certainly takes place with a difference of potential which is very far indeed below that which we know is required to produce a spark. On the other hand, it seems to be proved that in a Branly tube when acted upon by electric waves, chains of metallic particles are produced. The effect is not peculiar to electric waves. It can be accomplished by the application of any high electromotive force. Thus, Branly found that coherence may be produced by the application of an electromotive force of 20 or 30 volts, operating through a very high water resistance,

FIG. 36.



Blondel's Pocket Tube.

and thus precluding the passage of any but an excessively small current. Again, the coherence seems to take place in some cases when metallic particles are immersed in a liquid or even in a solid insulator. Professor Branly has therefore preferred to speak of masses of metallic granules as *radio-conductors*, and Professor Bose has divided substances into positive and negative, according as the operation of electromotive force is to increase the coherence of the particles, or to decrease it.

It has been asserted that for every particular Branly tube, there is a critical electromotive force in the neighbourhood of two or three volts, which causes the tube to break down and pass instantly from a non-conductive to a conductive condition, and that this critical electromotive force may become a measure of the utility of the tube for telegraphic purposes. Thus, C. Kinsley (*Physical Review*, vol. 12, p. 177, 1901) has made measurements of this supposed critical potential for different "coherers," and subsequently tested tho same as receivers at a wireless telegraph station of the U.S A. Signal Corps. The average of twenty-four experiments gave in one case 2·2 volts as the breaking down potential of one of these coherers or Branly tubes, 3·8 volts for a second, and 5·5 volts for the third. These same instruments tested as telegraphic kumascopes, showed that the first of the three was most sensitive.

On the other hand, W. H. Eccles (*Electrician*, vol. 47, pp. 682 and 715, 1901) has made experiments with Marconi nickel-silver sensitive tubes, using a liquid potentiometer made with copper sulphate to apply the potential, so that infinitesimal spark contacts might be avoided, and the changes in potential made without any abruptness. He states that if the coherer tube was continuously tapped at the rate of fifty vibrations per second, whilst at the same time an increase in potential was applied to its terminals, and the current passing through it measured on a galvanometer, there is no abrupt change in current at any point. He found that when the current and voltage were plotted against one another a regular curve was obtained, which after a time becomes linear. A decided change occurs in the conductivity of the mass of metallic filings when treated in this manner at voltages lower than the critical voltages obtained by previous methods. He ascertained that there was a complete correspondence between the sensitiveness of the tubes used as telegraphic instruments, and the form of the characteristic curve of current and voltage drawn by the above described method.

In the same manner, K. Guthe and A. Trowbridge (*Physical Review*, vol. 2, p. 22, 1900), investigated the action of a simple ball coherer formed of half-a-dozen steel, lead, or phosphor-bronze balls in slight contact. They measured the current i passing through the series under the action of a difference of potential v between the ends and found a relation which could be expressed in the form:—

$$v = V(1 - e^{-ki})$$

where V and k are constants.

The current through this ball coherer is therefore a logarithmic function of the potential difference between its ends of the form,

$$i = a \log (v - V)$$

and exhibits no discontinuity. The inference was drawn that the "resistance" is due to films of water adhering to the metallic particle, through which electrolytic action occurs.

A good metallic filings tube for use as a receiver in Hertzian wave telegraphy, should

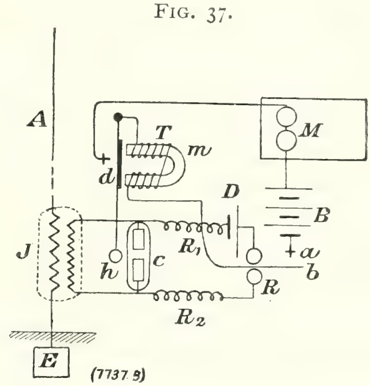
exhibit a constancy of action, and should cohere and decohere, to use the common term, sharply, at the smallest possible tap. It should not have a current passed through it by the external cell of more than a fraction of a milliampere, or else it becomes wounded and unsensitive.

The investigations which have already taken place seem to show pretty clearly that the agency causing the masses of filings to pass from a non-conductive to a conductive condition is electromotive force, and that therefore it is the electromotive force set up in the aerial by the incident waves which is the effective agent in causing the change in the metallic filings tube, when this is used as a telegraphic kumascope. This transformation of the tube from a non-conductor to a conductor, is made to act as a circuit-closer, completing the circuit by means of which a single cell of a local battery is made to send current through an ordinary telegraph relay, and so, by the aid of a second battery, operate a telegraphic printer or recorder of any kind. Hence, it is clear that after one impact, the metallic filings tube has to be brought back to its non-conductive condition, and this may be achieved in several ways: (1) by the administration of carefully regulated taps or shocks, or by rotating the tube on its axis; (2) by the aid of an alternating current; (3) in those cases where filings of magnetic metals are employed by magnetism.

The decoherence by taps was discovered by Branly,* and Popoff, following the example of Sir Oliver Lodge, employed an electric bell arrangement for this purpose.†

Mr. Marconi, in his original receiving instruments, placed an electro magnet under the coherer tube, with a vibrating armature like an electric bell‡ (see Fig. 37). This armature carries a small hammer or tapper, which, when set in action, hits the tube on the under side, and various adjusting screws are arranged for regulating exactly the force and amplitude of the blows. This tapper is actuated by the same current as the Morse printer, or other telegraphic recorder, so that when the signal is received, and the metallic filings tube passes into the conductive condition, and closes the relay circuit, this latter in turn closes the circuit of the Morse printer or other recorded, and at the same time a current passes through the electro-magnet of the tapper, and the tube is tapped back. This sequence of operations requires a certain time, which limits the speed of receiving. The tapper has to be so arranged that it is possible to receive and to record not only the *dot*, but a *dash*, on the Morse system. The *dash* is really a series of closely adjacent dots which run together in virtue of the inertia and inductance of the different parts of the whole receiving apparatus. The adjustment has so to be made that whilst the *dash* is being recorded, and a continuous tapping is kept up, yet nevertheless, the continuation of the electromotive force in the aerial due to the continually arriving trains of waves is able to act

FIG. 37.



TAPPING ARRANGEMENT.

against the tapping, and to keep the filings tube in its conductive condition. Hence the successful operation of the arrangement requires attention to a number of adjustments, but these are not more difficult, or even as difficult, as those involved in the use of many telegraphic receivers employed in ordinary telegraphy with wires.

We shall refer presently to the devices introduced by Mr. Marconi for preventing the sparks at the contacts of the electro-magnetic hammer from directly affecting the tube, and also to prevent the electric oscillations which are set up in the aerial from being partly shunted through other circuits than that of the sensitive tube.

We pass on to notice the remaining devices for restoring the metallic filings tube to a condition of sensitiveness or receptiveness.

A method for doing this by alternating currents, is due to Mr. S. G. Brown.* The

* See *The Electrician*, vol. 27, 1891, p. 448.

† "Journal of The Russian Physical and Chemical Society," vol. 28, Division of Physics, Part I., January, 1896.

‡ See British Patent Specification, No. 12,039, June 2, 1896.

* British Patent Specification, No. 19,710, of 1899.

pole pieces of the coherer tube are made of iron, and they are enveloped in magnetising coils traversed by an alternating electric current. Between these pole pieces are placed a small quantity of nickel or iron filings, and under the action of the electromotive force due to an electrive wave acting on them, may be made to cohere in the usual fashion, but the moment that the wave ceases, the alternating magnetism of the electrodes causes the filings to drop apart or decohere. In place of the alternating current, Mr. Brown finds that a revolving permanent magnet can be used to produce the alternating magnetisation of the pole pieces of the sensitive tube or coherer.

The third method of causing the decoherence of the filings is that due to T. Tommasina. He found that when a Branly tube is made with filings of a magnetic metal, such as iron, nickel, and cobalt, the decoherence of the filings can be produced by means of an electromagnet placed in a suitable position under the tube.* The explanation of this fect seems to be, that when an electric wave falls upon the tube, or when any other source of electromotive force acts upon it, chains of metallic particles are formed stretching from one electrode to the other. Tommasina contends that he has proved the existence of these chains of particles by experiments made with iron filings, and R. Malagoli,† in referring to Tommasina's assertion, states that it can be witnessed in the case of brass filings placed between two plates of metal and immersed in vaseline oil, when a difference of potential is made between the plates.

T. Sundorph‡ says he has confirmed Tommasina's discovery of the formation of these chains of metallic particles in the coherer. The filings do not all cling together, but certain chains are formed which afford a conducting path for the current subsequently passed through the coherer from an external source. Accordingly, Tommasina's method of causing decoherence in the case of filings of magnetic metals is to pull them apart by an external magnetic field, and he stated that decoherence can be effected more easily and regularly in this way than by tapping. Whilst on this point, it may be mentioned that C. Tissot* says that he has found that the sensitiveness of a coherent formed of nickel and iron filings can be increased by placing it in the magnetic field, the lines of which are parallel to the axis of the tube. According to A. Blondel and G. Dobkevitch, this is merely the result of an increased coherence of the particles.

On the general subject of the sensitiveness of metallic filings coherers formed of different metals, the researches of Professor J. C. Bose are well worth study.† He states that the sensitiveness of any such detector depends on the proper adjustment of the pressure between the particles and the value of the external electromotive force which is, so to speak, in waiting to send a current through them as soon as they are made to cohere. A large number of points of contact are, however, not necessary, if only the current which is subsequently passed through the contact kumascope is sufficiently small. Thus, Professor Branly says‡ that a very sensitive wave detector can be made with six steel balls like bicycle balls, placed in a row in a glass tube with some means of delicately adjusting the pressure, the resistance of such an arrangement may be initially two or three thousand ohms, and will drop to 100 ohms or less when a wave acts upon it. Contact detectors of the same type can also be made with liquid metals. Thus, Tommasina in 1899§ made a sensitive coherer by enclosing a drop of mercury between two brass electrodes in a glass tube, and numerous varieties of coherer have been constructed, involving the use of one or two globules of mercury.

We have next to notice the type of contact kumascope or coherer which is, in common language, self-decohering, or, as I prefer to call it, self-restoring. As we have already seen, Professor D. E. Hughes, in 1879, found that a carbon-steel microphone had this property, and some varieties of carbon, when used in granules, possess it. Thus, Tommasina‖ found a variety of carbon used in the microphones of Swiss telephones which decoheres spontaneously when the electric waves cease to act upon it.

At this stage it may be well to explain that

* *Comptes Rendus*, vol. 128, p. 1225, 1889; or *Science Abstracts*, vol. 2, p. 521.

† "Il Nuovo Cimento," vol. 10, p. 979, 1899.

‡ "Wied: Ann:" vol. 67, p. 594, 1899; or *Science Abstracts*, vol. 2, p. 757.

* *Comptes Rendus*, vol. 130, p. 902, 1900; or *Science Abstracts*, vol. 3, p. 615.

† See "Proc. Roy. Soc.," vol. 65, p. 166, 1889.

‡ *Comptes Rendus*, vol. 128, p. 1089, 1899; or *Science Abstracts*, vol. 2, p. 520.

§ *Comptes Rendus*, vol. 128, p. 1092; or *Science Abstracts*, vol. 2, p. 521.

‖ *Comptes Rendus*, vol. 130, p. 904, 1900.

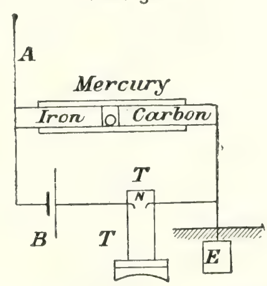
two methods have been employed in connection with kumascopes of various types for making telegraphic signals. One of these may be called the *telegraphic method*, and the other the *telephonic method*. In the first case, the variation of resistance which the coherer or other detector undergoes on the impact of the wave, is employed to start or stop, increase or decrease the current from a single cell passing through an ordinary telegraphic relay in series with the kumascope, and this relay in turn is made to close another circuit, thus working any type of single current telegraph receiver, such as the ordinary Morse printer. In this case, the current which is to be passed through the coherer and relays by the cell, must be at least the tenth of a milliampere, as that is the smallest current which will work comfortably an ordinary Siemens or Post Office relay.

The other method of employing the coherer is in conjunction with a telephone and voltaic cell. The variation in resistance of the coherer is made to increase or decrease the current through a telephone, with or without the interposition of a small induction coil, or of a condenser, and thus a current which acts upon the telephone, and therefore to produce a tick or sound in the telephone at each change of resistance of the coherer. If a dash has to be registered, then it is achieved by the production of a rapid series of variations and recoveries in the resistance of the coherer, and this produces a series of rapidly succeeding ticks which are heard as an almost continuous sound. Hence the operator listening with the telephone at his ear, hears a tick corresponding to the Morse dot, and a longer sound corresponding to the dash.

This mode of operating has the advantage of great sensibility, because nothing surpasses the telephone, combined with the human ear, as a detector of current variation. A very small current passed through the coherer can make itself audible as a sound or telegraphic sign when suddenly interrupted. Accordingly, self-restoring coherers have generally been used in connection with a telephone as the receiving instrument.

One of the most sensitive of these devices is the carbon-steel-mercury coherer, the invention of which has been attributed to Castelli, a signalman in the Italian navy,* but it has been stated on good authority to have been the invention of officers in the Royal Italian Navy, and has therefore been called the Italian Navy coherer.* This instrument has been arranged in several forms, but in the simplest of these it consists of a glass tube having in it a plug of iron and a plug of carbon. The plugs of iron, or of iron and carbon, are separated by an exceedingly small globule of mercury, the size of which should be between one and a half and three millimeters. (See Fig. 38.) The plugs of iron or carbon closing the tube must be capable of movement, one of them by means of a screw. One of the plugs of this tube is connected to the aerial and the other to the earth, and they are also connected through another circuit composed of a single dry cell and a telephone. The arrangement

FIG. 38.



ITALIAN NAVY KUMASCOPE.

then forms an extremely sensitive detector of electric waves, or of small electromotive forces, for if a wave falls on the aerial the electromotive force at once improves the contact between the mercury and the plugs, and therefore causes a sudden increase in the current through the telephone, giving rise to a sound, but when the wave ceases, or the electromotive force is withdrawn, the resistance falls back again to its original value, and the arrangement is therefore self-acting, requiring no tapping or other device for restoring it to receptivity.

Quite recently, Sir Oliver Lodge and Dr. Muirhead have employed as a self-restoring coherer or kumascope, a steel disc revolved by clockwork, the edge of which just touches a globule of mercury covered with a thin film of paraffin oil. (See Fig. 39.) The contact is made between the mercury and the steel by the electric wave generating an electromotive force in the aerial suffi-

* See report by Captain Quintino Bonomo: "Telegrafia senz fili," Rome, 1902; or *L'Elettricista*, Ser. II., vol. 1, pp. 118, 173.

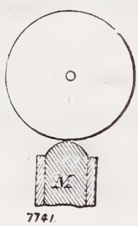
* See "Royal Institution Friday Evening Discourse," Mr. Marconi, June 13th, 1902; also *The Electrician*, vol. 49, p. 490; also a letter to the *Times* of July 3rd, 1902, by the Marchese Luigi Solari.

cient to break through the thin film of oil. When the wave stops, the circuit is again interrupted automatically.

This device is used without a relay to actuate directly a syphon recorder as used in submarine telegraphy. The working battery employed with it must only have an electromotive force of a fraction of a volt. It may be used also with a telephone in circuit, and can therefore be employed either for telegraphic or telephonic reception.*

A very ingenious form of combined telephone and coherer has been devised by T. Tommasina. In this instrument, the diaphragm of an ordinary Bell telephone carries upon it a very small carbon or metallic coherer. This coherer is connected in between the aerial and the earth, and is also in circuit with a battery, and the electro-magnet of a telegraphic relay. When this relay operates, it closes the circuit of another battery which is placed in series with the telephone coil. The moment

FIG. 39.



LODGE-MUIRHEAD KUMASCOPE.

the current passes through the telephone coil it attracts, and therefore vibrates, the diaphragm and shakes up the metallic filings. If an observer therefore places the telephone to his ear, he hears a sound corresponding to every train of waves incident upon the aerial. With this arrangement, one can obtain two different kinds of results, according to the nature of the cohering powder placed in the cavity in the diaphragm. First, if the powder consists of a non-magnetic metal, gold, silver, platinum, or the like, the receiver will be very sensitive, and at the same time the current passing through it when it is cohered will be sufficient to work a sensitive recording apparatus in series with the telephone coil. Secondly, if the metallic powder placed in the cavity is a magnetic metal, the receiver will be somewhat less sensitive, but will work with more precision, because of the magnetic action of the magnet of the telephone upon the cohering powder. If no recording apparatus is used, the observer must write down the signals as heard in the telephone, since corresponding to a short spark at the transmitting station, a single tick or short sound is heard at the telephone, and corresponding to a series of rapidly successive sparks, a more prolonged sound is heard in the telephone. These two sounds, as already explained, constitute the dot and the dash of the Morse signals.

We may in the next place refer to that form of kumascope in which the action of the wave or of electromotive force is not to decrease the resistance of a contact, but to increase that of an imperfect contact. As already mentioned, Professor Branly discovered long ago that peroxide of lead acts in an opposite manner to metallic filings, in that when placed in a Branly tube it increases its resistance unde the action of an electric spark, instead of decreasing it. Again, Professor Bose has found that fragments of metallic potassium in kerozene oil behave in a similar manner, and that certain varieties of silver, antimony, and of arsenic, and a few other metals have a similar property. Branly tubes, therefore, made with these materials, or any arrangements which act in a similar manner, have been called "anticoherers." The most interesting arrangement which has been called by this name is that of Schäfer.* Schäfer's kumascope is made in the following manner:—A very thin film of silver is deposited upon glass, and a strip of this silver is scratched across with a diamond, making a fine traverse cup or gap. If the resistance of this divided strip of silver is measured, it will be found not to be infinite, but may have a resistance as low as 40 or 50 ohms, if the strip is 30 millimeters wide. On examining the cut in the strip with a microscope, it will be found that the edges are ragged and that there are little particles of silver lying about in the gap. If then an electromotive force of three volts or more is put on the two separated parts of the strip, these little particles of silver fly to and fro like the pith balls in a familiar electrical experiment, and they convey electricity across from side to side. Hence a current passes having a magnitude of a few milliamperes. If, however, the strip is employed as a kumascope, and connected at one end to the earth and at the

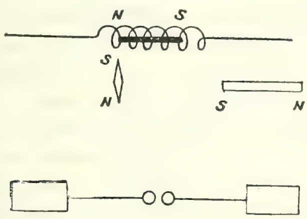
* See "Proc. Royal Soc.," London, vol. 71., page 02, 1903.

* See E. Marx, *Phys. Zeitschrift*, vol. 2, p. 949; or *Science Abstracts*, vol. 4, p. 471. See also German Patent Specification, No. 191,663, Class 21a.

other end to an aerial, when electric waves fall upon the aerial, the electrical oscillations thereby excited seem to have the property of stopping this dance of silver particles, and the resistance of the gap is increased several times, but falls again when the wave ceases. If threfore a telephone and battery are connected between two portions of the strip, the variation of this battery current will affect the telephone in accordance with the waves which fall upon the aerial, and the arrangement becomes therefore a wave-detecting device. It is said to have been used in wireless telegraph experiments in Germany up to a distance of 95 kilometers.

We must next direct attention to those wave-detecting devices which depend upon magnetisation of iron, and here we are able to record recent and most interesting developments. More than 70 years ago, Joseph

FIG. 40.

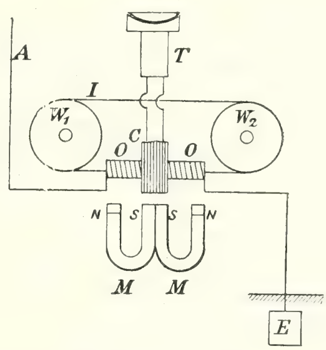


Rutherford's Magnetic Hertzian Wave Detector.

Henry, in the United States, noticed the effect of an electric spark at a distance upon magnetised needles.* Of recent times, the subject came back into notice through the researches of Mr. E. Rutherford, who carried out at Cambridge in 1896 a valuable series of experiments on this subject.† He found that if a magnetised steel needle or a very small bundle of extremely thin iron wires is magnetised, and placed in the interior of a small coil, the ends of which are connected to two long collecting wires, then an electric wave started from a Hertz oscillator, at a distance, causes an immediate demagnetisation of the iron (see Fig. 40). This demagnetisation he detected by means of the movement of the needle of a magnetometer placed near one end of the iron wire. Although Rutherford's wave-detector has been much used in scientific research, it was not in the form in which he used it, a telegraphic instrument, and could not record alphabetic signals.

Mr. Marconi has invented, however, a telegraphic instrument based upon his discovery that the magnetic hysteresis of iron can be annulled by electric oscillations. In one form, Mr. Marconi's magnetic receiver is constructed as follows* :—An endless band of thin iron wire composed of several iron wires about No. 36 gauge, arranged in parallel, is made to move slowly round on two pulleys, like the driving-belt of a machine. In one part of its path, the wire passes through a glass tube, on which are wound two coils of wire, one a rather short thick coil, and the other a very fine long one. The fine long coil is connected with a telephone, and the shorter coil is connected at one end to the earth and the other to the aerial. Two permanent horse-

FIG. 41.



MARCONI'S MAGNETIC TELEGRAPHIC KUMASCOPE.

shoe magnets are placed as shown in Fig. 41, with their similar poles together, and as the iron band passes through their field, a certain length of it is magnetised, and owing to the hysteresis of the material, it retains this magnetism for a short time after it has passed out of the centre of the field. If, then, an electric oscillation coming down from the aerial is passed through the shorter coil, it changes the position of the magnetised portion of the iron, and, so to speak, brings the magnetised portion of iron back into the position it would have occupied if the iron had had no hysteresis. This action, by varying the magnetic flux through the secondary coil, creates in it an electromotive force which causes a sound to be heard in the

* See "The Scientific Writings" of the late Professor Joseph Henry.

† "Phil. Trans. Roy. Soc," 1897, vol. 189A, p. 1.

* See "Proc. Roy. Soc. Lond.," June 12th, 1902. "Note on a Magnetic Detector for Electric Waves, which can be employed as a Receiver for Space Telegraphy." By G. Marconi.

telephone connected to it. If, at a distant place, a single wave or train of waves is started and received by the aerial, this will express itself by making an audible tick in the telephone, and if several groups of closely adjacent wave trains are sent, these will indicate themselves by producing a rapid series of ticks in the telephone heard as a short continuous noise, and taken as equivalent to the Morse *dash*.

It was by means of this remarkably ingenious instrument that Mr. Marconi was able, in the summer of 1902, to detect the waves sent out from Poldhu, on the coast of Cornwall, and receive messages, as far as Cronstadt, in the Baltic, in one direction, and as far as Spezzia, in the Mediterranean, in another direction, and also to receive messages across the Atlantic from the power stations situated in Glace Bay, in Nova Scotia, and from one at Cape Cod, in Massachusetts, U.S.A., in December, 1902.

There can be no question that this magnetic kumascope of Mr. Marconi's, used in connection with a good telephone, and an acute human ear, is the most sensitive device yet invented for the detection of electric waves, and their utilisation in telegraphy without continuous wires. It is marvellously simple, ingenious, and yet effective, as a Hertzian wave telegraph receiver.

Whilst on the subject of magnetic wave detectors, I may describe experiments that I have been recently making to construct a Hertzian wave detector on the Rutherford principle which shall be strictly quantitative. All the receivers of the coherer type and electrolytic type give no indications that are at all proportional to the energy of the incident wave. Their indications are more or less accidental, and depend upon the manner in which the receiver was last left. There is a great need for a quantitative wave detector, the indications of which shall give us a measure of the energy of the arriving wave. It is only by the possession of such an instrument that we can hope to study properly the sending powers of various transmitters, or the efficiency of different forms of aerial, or devices by which the wave is produced. My magnetic receiver is constructed as follows :—A coil of fine wire is constructed in sections, like the secondary coil of an induction coil, and in the instrument I have made this coil contains 30 or 40 thousand turns of wire. In the interior of this coil are placed a number of little bundles of fine iron wire, each wound round with two coils, a fine wire coil which is a magnetising coil, and a thicker wire coil, which is a demagnetising coil. These sets of coils are joined up respectively in series or in parallel. Then, associated with this form of induction coil I have a commutator of a peculiar kind, which performs the following functions when a battery is connected to it, and when it is made to revolve by a motor or by clockwork. First, during part of the revolution, the commutator closes the battery circuit, and magnetises the iron cores, and whilst this is taking place the secondary circuit of the induction coil is short circuited, and the galvanometer is disconnected from it. Secondly, the magnetising current is stopped, and soon after that the secondary coil is unshortcircuited and connected to the galvanometer, and remains in this condition during the remainder of the revolution. This cycle of operations is repeated at every revolution. If, then, an electrical oscillation is sent into the demagnetising coils, and if it continues longer than one revolution of the commutator, it will demagnetise the iron core during that period of time in which the battery is disconnected and the galvanometer connected. The demagnetisation of the iron which ensues produces an electromotive force in the secondary coil, and causes a deflection of the galvanometer, and this deflection will continue and remain steady if the oscillation persists. Moreover, since this deflection is due to the passage through the galvanometer of a rapid series of discharges, it is large when the oscillations continue for a long time and are powerful, and small when they continue for a short time, or are weak. I can, therefore, with this arrangement, receive on the galvanometer just as on the mirror galvanometer used in submarine cable work, a dot or dash, and moreover, the magnitude of these deflections is a measure of the energy of the wave.

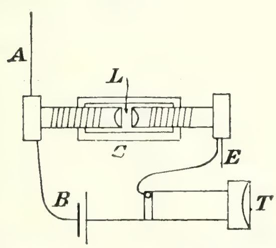
I think when this arrangement is perfected, it will become exceedingly useful for making all kinds of tests and measurements, in connection with Hertzian telegraphy, even if it is not sensitive enough to use as a long distance receiver. Magnetic kumascopes have also been devised by Profs. E. Wilson, J. A. Ewing, and R. Fessenden.

Of late years, a variety of wave-detecting devices have been brought forward which depend upon electrolysis. One of the best known of these is that by De Forest and Smythe.* In this arrangement, a tube con-

* See U.S.A. Patent Specification, No. 716000, application of July 5th, 1901.

ains two small electrodes like plugs, which nay be made of tin, silver, or nickel, or other netal. The ends of these plugs are flat, and separated from each other by about one two-hundredth of an inch. Sometimes the end of one of these plugs is made cup shaped, and the cup or recess is filled with a mass of peroxide of lead and glycerine. (See Fig. 42.) In the interval between the electrodes is placed an electrolisable mixture which consists of glycerine or vaseline mixed with water or alcohol, and a small quantity of litharge and metallic filings. These metallic filings act as secondary electrodes. When a small electromotive force is applied between the terminals of the electrodes of this tube, through a very high resistance of 20,000 or 30,000 ohms, an exceedingly small current passes through this mixture, and it causes an electrolytic action which results in the production of chains of metallic particles connecting the two

FIG. 42.



DE FOREST ELECTROLYTIC KUMASCOPE.

electrodes together. If, in addition to this, one terminal or electrode of the arrangement is connected to an aerial wire, and the other terminal to the earth, then on the arrival of an electric wave creating oscillations in the wire, these oscillations pass down into the electrolytic cell, where they break up the chains of metallic particles, and thus interrupt the current passing through the telephone quite suddenly, which is heard as a slight tick by an ear applied to it. As soon as the wave ceases the chain of metallic particles is re-established, so that the appliance is always in a condition to be affected by a wave. It is said that this breaking up and reformation of the chains of metallic particles is so rapid that a short spark made at the transmitting station is heard as a tick in the telephone, but a rapid succession of oscillatory sparks is heard as a short continuous sound ; hence the two signals necessary for alphabetic conversation can be transmitted.

Another receiver which has some resemblance to the above, although different in principle, is that of Neugschwender.* In this arrangement, which to a certain extent resembles the Schäfer detector, a glass plate has upon it a deposit of silver in the form of a strip, which is cut across at one place, thus interrupting it. If the cut is breathed upon or placed in a moist atmosphere, a little dew is deposited upon the glass which bridges over the cut in the metal and creates an electric continuity. Hence a small current can be passed across the gap and through a telephone, by one or two cells of a battery. If, however, an electric oscillation passes across the gap on its way from an aerial to the earth, then the continuity of the liquid film is destroyed, and the current is interrupted, and a sound created in the telephone.

The opinion has been expressed by Sir Oliver Lodge that in this case the interruption of the circuit whieh occurs is really due to the coalescence of minute water particles into larger drops, as when vapour is condensed into rain, and hence the continuity of the material is interrupted.

We must then make a brief reference to other kumascopes which depend upon the heating power of an electrical oscillation, which it possesses in common with every other form of electric current. Professor R. A. Fessenden† has constructed a thermal receiver in the following manner. An extremely fine platinum wire, about 0·003 of an inch in diameter, is embedded in the middle of a silver wire, about one-tenth of an inch in diameter, like the wick of a candle. This compound wire is then drawn down until the diameter of the silver wire is only ·002 of an inch, and hence the platinum wire in its interior, being reduced in the same ratio, will have been drawn down to a diameter of ·00006 inch. A short piece of this drawn down wire is then bent into a loop, and the ends fixed to wires. The tip of the loop is then immersed in nitric acid, and then dissolved in the silver, leaving an exquisitely fine platinum wire a few hundreds of an inch in length and having a resistance of about 30 ohms. (See Fig. 43.) This little loop is sealed into a glass bulb, like a very small incandescent lamp, or it may be enclosed in a small silver bulb, and the air may be exhausted. If an electrical oscillation is sent through this exceedingly fine platinum wire, it heats it, and rapidly in-

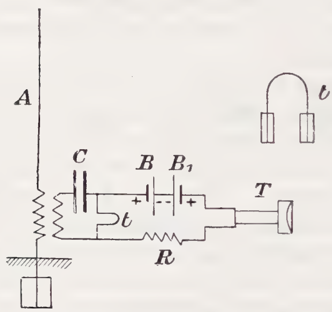
* See *The Electrical Review*, vol. 44, May 26, 1899 ; or "Wied. Ann.," vol. 68, p. 92 ; or German Patent Specification, No. 107843.

† U.S.A. Patent Specification, No. 706742, 1902.

creases its resistance. The electrical oscillations produced in an aerial are sent through a number of these loops arranged in parallel, and the the loops are short-circuited by a telephone, joined in series with a source of very small electromotive force produced by shunting a single cell, or opposing to one another two cells of nearly equal electromotive force. Any variation of resistance of the little platinum loops due to the heat produced by the oscillations, by suddenly altering the current flowing through the telephone, will cause a sound to be heard in it. The electrical oscillations when passing through the loops are therefore detected by the heat which they generate in these exquisitely fine platinum wires.

Finally, one word must be said on the subject of electro-dynamic receivers, due to the same inventor. An exceedingly small silver ring is

Fig. 43.



Fessenden's Thermal Receiver.

suspended by a quartz fibre, and has a mirror attached to it in the manner of a galvanometer. This ring is suspended between two coils joined in series, which are placed either in the circuit of the aerial, or in the secondary circuit of the small air core transformer inserted between the aerial and the earth. When electrical oscillations travel down the aerial, they induce other electrical oscillations in the silver ring; and if the ring is so placed that its normal position is with its plane inclined at an angle of 45 degrees to the plane of the fixed coils, then the ring will be slightly deflected every time an oscillation occurs in the aerial.

Omitting further mention of the details of the kumascopes in use, and the receiving aerial, we must next proceed to consider the receiving arrangements taken as a whole.

In the original Marconi system, the sensitive tube or coherer was inserted betwen the bottom of the receiving aerial and the earth.* Accordingly, when the incidental electric wave strikes the receiving aerial, and creates in it an oscillatory electromotive force, this last will, if of sufficient amplitude, cause the particles of the coherer to cohere and become conductive. This sudden change from a nearly perfect non-conductivity to a conductive condition is made to act as a switch or relay, closing or completing the circuit of a single cell, and so sending a current through an ordinary telegraphic relay which may in turn actuate another recording telegraphic instrument, such as a Morse printer. To prevent the oscillations from passing into the relay circuit, small choking or inductance coils are inserted between the ends of the sensitive tube and the relay and cell, and serve to confine the oscillations to the tube.

It has already been pointed out that in the transmitting aerial the amplitude of the potential vibrations increases from the bottom to the top, and when vibrating in its fundamental manner there is a potential node at the earth connection, and a potential loop or antinode at the top. The same is true of the receiving aerial. Hence if the kumascope employed is a Branly metallic filings tube, and is inserted near the base of the aerial, the difference of potential between its two ends will be small.

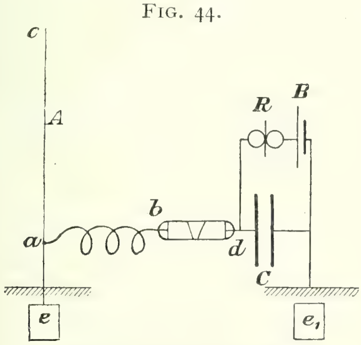
It has also been pointed out that a receiver of this type acts in virtue of electromotive force or potential difference, and hence the proper places to insert the coherer is not at the base of the aerial, but between the top of the aerial and the earth. This, however, could not be done by running up another wire from the earth, as that would amount to putting the coherer between the tops of two identical aerials, and between its ends there would be no difference of potential. Professor Slaby, in conjunction with Count von Arco, has given an ingenius solution of this problem. If we take two equal lengths of wire bent at right angles, and connect the point of intersection with the earth, placing one of these wires vertically, and the other horizontally, we then have an arrangement which responds to the impact of electric waves, and has electrical oscillations set up in it in such fashion that the common point of the two wires has a very small amplitude of potential, but the two extremities have equal and large variations. If then we insert a coherer tube between the

* See British Patent Specification, G. Marconi, No. 12039, June 2nd, 1896.

earth and the outer extremity of the horizontal wire, it is influenced in the same manner as it would be by the potential variations at the top of the vertical wire; in other words, it is acted upon by a large difference of potential instead of a small one. It is not found necessary to stretch the horizontal wire out straight; it may be coiled into a spiral with open turns, and the slight decrease in capacity and increase in inductance resulting from this, can be compensated by cutting off a short piece of it.

In this way we have an arrangement (see Fig. 44), in which the outer extremity of this open spiral experiences variations of potential which exactly correspond with those at the summit of the vertical aerial. The receiving arrangements are then completed as in Fig. 44,

FIG. 44.



SLABY TUNED RECEIVER.

one end of the coherer being attached to the outer end of the spiral, and the other end through a condenser to the earth, a relay and a voltaic cell being arranged as shown in the diagram. The mode of operation of this receiver is as follows;—When the wave strikes the aerial it sets up in it electrical oscillations with a potential antinode at the summit, and, at the same time, a potential antinode is created at the outer end of the spiral attached near the base of the aerial, this spiral being called by Professor Slaby, a *multiplicator*. As long as the coherer tube remains non-conductive, the local cell cannot send a current through the relay, but as soon as the resistance is broken down by the impact of a wave, the local cell sends a current through the coherer tube which passes down to the earth through the base of the aerial, and up through the earth connection to the condenser, completes its circuit through the relay. Many variations of this arrangement have been made by Slaby and Von Arco, and by the Allgemeine Elektricitäts Gesellschaft of Berlin.

In 1898, Mr. Marconi made a great advance in the construction of his receiving apparatus by the insertion of his "jigger" or oscillation transformer in the aerial receiving circuit.* In this arrangement, the primary coil of an air core transformer of a special kind, is inserted in between the receiving aerial and the earth, and the secondary circuit is cut in the middle and connected to the two surfaces of a condenser, these surfaces being also connected through the circuit of an ordinary telegraphic relay, and a single cell.† The ends of the secondary circuit of this oscillation transformer are also connected to the terminals of the coherer tube, and these again are short-circuited by a small condenser.

The operation of this receiver is as follows:—The oscillations set up in the aerial pass through the primary circuit of the jigger, and these induce other oscillations in the secondary circuit, the electromotive force or difference of potential between the primary terminals being transformed up in any desired ratio. It is this exalted electromotive force which is made to act on the coherer tube, and inasmuch as the jigger operates in virtue of a current passing through its primary circuit, and this current is at a maximum at the lower end of the aerial, the arrangement is exceedingly effective, because it, so to speak, converts current into voltage. At the lower end of the aerial, although the amplitude of the potential oscillations is at a minimum, the amplitude of the current oscillations is at a maximum, and the jigger transforms these large current oscillations into large potential oscillations, *provided it is constructed in the right manner*.

It will be noticed, therefore, that the receiving aerial may be arranged in one of two ways; it may either be earthed at the lower end or it may be insulated. It has been claimed that there is a great advantage in earthing the receiving aerial directly, in that it eliminates atmospheric disturbances.

I shall allude to this point more particularly in the last lecture. Meanwhile, it may be mentioned that the receiving arrangements, as a whole, constitute a very sensitive arrangement, as shown by Popoff, Tommasina, and by all the large experience of Mr. Marconi himself, for detecting changes in the

* See G. Marconi, British Specification, No. 12326, of June 1st, 1898.

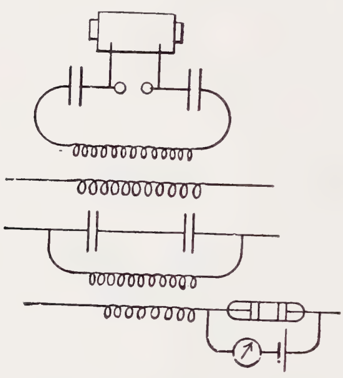
† Sir Oliver Lodge suggested in 1897 (see British Patent Specification, No. 11575 of 1897) the actuation of the coherer by transformed oscillations, but no details were given as to its construction, and everything depends upon the form of winding.

electrical condition of the atmosphere, which are doubtless of the nature of electrical oscillations.

On the other hand, the receiving arrangements may be perfectly insulated, and some experimentalists have asserted that by this method the greatest freedom is secured from atmospheric disturbances. Amongst the non-earthed arrangements, the system invented by Professor F. Braun, of Strassburg, and worked by Messrs. Siemens, of Berlin, may be mentioned.*

Professor Braun's arrangements are indicated in the diagrams in Fig. 45. In this case, an induction coil is used to create a discharge between two spark balls, and to these two balls are connected the two outer coatings of two condensers, the inner coatings

FIG. 45.



BRAUN'S SYNTONIC SYSTEM.

of which are connected together through the primary coil of an air core transformer.

The secondary coil of this transformer is connected to two extension wires forming a Hertz resonator, and the length of these wires is so adjusted with reference to the time period of the primary circuit, that they resonate to it, the whole length from end to end of the secondary circuit being half a wave length. The receiver, as shown in the diagram, consists of a pair of quarter wave length receiving wires, connected through two condensers, which are short-circuited by the primary coil of an oscillating transformer. The secondary circuit of this last oscillating transformer has two extension wires to it, tuned in the same manner to respond to the primary oscillator, and in the circuit of one of these extension wires is placed a coherer tube, short-circuited by a relay, and a local battery.

* See *Electrical Review*, Sept. 26th, 1902, vol. 51, p. 543.

It will thus be seen that there is an entire abolition of ground connection, which Professor Braun claims practically avoids all atmospheric disturbances.* The details of the receiving arrangement are as follows:—The coherer tube consists of an ebonite tube, containing hard steel particles of a uniform size, placed in the adjustable space between two polished steel electrodes. It is found that with this steel coherer a small amount of magnetism in the particles increases its sensitiveness, and to obtain this a ring magnet is employed in connection with a coherer tube.

Receiving apparatus arranged on this system is said to have been used for telegraphing between Heligoland and Cuxhaven, a distance of 36 miles.

All the immense experience, however, gained by Mr. Marconi, and those who have worked with his system, is in favour of using the earth connection. There is no doubt that Hertzian wave telegraphy can be conducted over short distances by means of totally insulated aerials, but for long distances the earth connection is essential, for the reasons that have been explained in the first lecture.

There are many of the details of the receiving arrangements which remain to be considered. If the communication is received by a telegraphic instrument like the Morse printer, which requires a current of anything like ten milliamperes to work it, then an important element in the receiving arrangement is the relay. The relay that is generally used is a modified form of the Siemens polarised relay, which is adjusted as to make a single contact. For marine work on board ship, it is essential that this relay shall be balanced so that variations in position shall not affect it. Sometimes the relay is hung in gimbals like a compass, and at other times suspended from a support by elastic bands so as to avoid jolting. In any case the relay must be so adjusted that no change of position will cause it to close the circuit of the telegraphic printer or recorder. Its sensibility ought to be such that it is actuated by a tenth of a milliampere, and if possible, even by less. The alteration of sensibility in the ordinary contact form of relay is the pressure that is necessary to bring the platinum points of the circuit closer together,

* There is a good deal of contradiction between various inventors on this point, some saying that "earthed" aerials obviated atmospheric electric disturbances, and others, that insulated aerials are in this respect superior. The truth appears to be that neither form is absolutely free from risk of disturbance by this cause.

so as to pass the minimum current which will work the telegraph printer. We have here to deal with the difficulties of a microphonic contact.

I have been engaged for some time past on experiments to ascertain if any other form of contact can be used which requires no pressure at all. One form of relay which I have been successful in working with a 50th of a milliampere, employs a flame of petroleum as one of the contacts, which is saturated with certain potassium salts. These have the property of making the flame a very good conductor. If, then, a galvanometer of the movable coil type has fixed to its coil a long indicating needle ending in a platinum point, the tipping of this platinum point into the flame can be made to close the circuit of a Morse printer.

I may allude here also to the exceedingly ingenious and sensitive relay devised by Mr. S. G. Brown, which he described some time ago to the Institution of Electrical Engineers.* I am told that this relay will work with something under a hundredth of a milliampere, which certainly seems an exceedingly small current.

The important matter, however, in connection with the use of the relay in Hertzian wave telegraphy is that it should be capable of adjustment without extraordinary skill. It is no use to put into the hands of an operator a relay which requires abnormal dexterity to make it work at all.

The advantage of the telephonic methods of reception is that no mechanical relay is necessary. The human operator acts as the relay, and sitting with the telephone at his ear, writes down the signals as received, but the disadvantage of the telephone method is that if a word or two is indistinct, there is no possibility afterwards, by looking at the message as a whole, of guessing from a letter or two the meaning of the missing words. This is not a very important matter in simply sending familiar or trivial messages, but in the case of code messages, where the signals sent do not make intelligible words, the missing or misinterpretation of a single letter may totally alter the meaning of a whole message. Hence in this, as in every other thing, there is a balance of advantage. The telephonic methods of reception are more sensitive, the telegraphic methods are probably more certain; but, on the other hand, the telephonic methods are capable of a greater speed. In spite of everything that has been said to the contrary, an average speed of twelve or fifteen words a minute is all that is attained in practice, by ordinary operators, when working with a single receiver involving a metallic filings coherer, a tapper, a relay, and a Morse printer. Whereas, with the telephone methods, reception can be as quick as by any of the ordinary sounders, *i.e.*, an experienced operator can receive by ear probably up to thirty-five or forty words a minute, provided the sending can be effected as quickly.

We shall proceed in the next lecture to consider some of the problems presented when we consider not merely the receiver or transmitter, but the two taken together, as constituting a telegraphic system.

* See "Journal of the Inst. of Elec. Engineers," vol. 31, p. 1062. Also British Patent Specification, No. 1434 of 1899.

Miscellaneous.

EMBROIDERIES AT THE VICTORIA AND ALBERT MUSEUM.

Some fine examples recently added to the collection of ecclesiastical embroidery at South Kensington are now exhibited in the Tapestry Court. They were obtained from the Hochon Collection, which was lately sold in Paris. The Museum owes one of the best among them to the generosity of Mr. J. H. Fitzhenry, who placed at the disposal of the authorities a sum sufficient to purchase the beautiful Italian orphrey dating from the second half of the 14th century, No. 831 (1903). It is remarkable both for beauty and fineness of workmanship, and for the simple and expressive manner in which the artist has told the story of the Virgin Mary. The subject is represented in nine scenes, beginning with the rejection of Joachim's offering in the Temple, and ending with the Assumption of the Virgin. The orphrey probably belonged to a cope, and may be compared with that on the cope No. 580 (1884), exhibited in a wall-case in the Italian Court. An English orphrey, No. 827 (1903), comes in no degree behind this Italian example in technical qualities, and forms another illustration of the pre-eminence of English embroideries in the earlier Gothic period. "Opus Anglicum" had acquired a celebrity on the continent of Europe before the middle of the 13th century, and beautiful examples dating from that and the following century, and shewing unmistakable signs of English origin, are still to be found in Italy, Spain, France, and elsewhere. The orphrey in question belongs to the close of the 13th century, and may be compared with the famous Syon cope, and other less-known early English embroideries,

exhibited among the vestments adjoining the Italian Court. Part of another English orphrey, in two pieces, Nos. 828 and 829 (1903), belongs to a slightly later period. Two complete chasubles were also acquired, one of green brocade, No. 830 (1903), one with French orphreys of the 15th century embroidered with female saints, and the other of green velvet, No. 825 (1903), with a fine Flemish orphrey of the early years of the 16th century, representing a Tree of Jesse. Two bands of Cologne work, Nos. 823 and 824 (1903), illustrating the possibilities of combining the weaver's and embroiderer's art, date from the latter part of the 15th century. One other piece may be mentioned—an orphrey from a chasuble, No. 826 (1903), bearing the date 1526 on a cartouche beneath the central figure of David, and most probably of French workmanship. It forms a simple and useful example of Continental work at a period when the art of the embroiderer in this country, after a decline during the Wars of the Roses, shone again for a brief period before its practical extinction, as far as ecclesiastical work is concerned, at the dissolution of the monasteries.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty, in May and June last :—

New Charts.—No. 3339—Ireland, west coast; approaches to Galway bay. 3335—Labrador and Newfoundland; approach to strait of Belle Isle (reproduction). 3348—West Indies, Culebra, south coast; Great harbour. 3326—South America, east coast; Bom Ambrigo island to Arvoredo I. 3333—British Columbia, Johnstone strait sheet II. (central). 3350—China, Yang tse Kiang; sketch of the Poyang lakes. 3341—Gulf of Tartary, southern sheet. 3340—Gulf of Tartary, northern sheet. 309—Australia, south coast; Port Phillip, west channel (reproduction). 2521—New Zealand; Tauranga. 3343—New Zealand; Gable end foreland to Poverty bay. 193—Plans in the Mediterranean; new plan :—Linosa island. 1313—Chile; the channels between port de Ancud and port Montt; new plan :—Port Montt. 2346—Plans on the coast of Chile; new plan :—Coloso cove. 648 — Africa, east coast; Delagoa bay to river Zambesi: plan added :—Port Bartholomew Diaz. 14—Harbours and anchorages in the Red sea; plans added :—Akik Seghir; Eid road. 751—India, west coast, sheet XIII.; plan added :—Kolachel anchorage. 2193—Sketch plan of anchorages between Mindanao and Celebes; plans added :—Arangkaä anchorage, Ngalipaeng bay, Sawan and Ulu roads, Dago bay, Karaton anchorage; new plan :—Petta anchorage. 998—Malay peninsula; Pulo Kapas to Lakon roads; plan added :—Entrance to Kalantan river.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners :—

Nos. 1188—The world; coal and telegraph chart. 2585—England; Coastguard stations. 2586—Scotland; Coastguard stations. 2587—Ireland; Coastguard stations. 2307—Norway, sheet V., Smölen to Sves fiord. 2246—Baltic sea; Port Baltic to Hogland. 173—Baltic sea; approaches to Helsingfors and Sveaborg. 2247—Baltic sea; Hogland to Seskär, north shore. 2826—Baltic sea; approaches to Viborg. 2215—Baltic, Gulf of Finland; Kronstadt, north and south channels. Baltic sea; Libau to Lyserört. 2371—Baltic sea; Memel to Libau. 1456—Mediterranean, Ægean sea; plans of anchorages in the Morea. 1661—Mediterranean, Ægean sea; Port Mudros. 1569—Africa, north coast; approaches to Bizerta. 2282-Arctic ocean and Greenland sea. 565—Iceland, western portion. 566—Iceland, eastern portion. 2818—United States, east coast; Hampton roads and Elizabeth river. 1452—Bahamas, Nassau harbour. 3316—West Indies, Leeward islands; Puerto Rico island :—Guayanilla harbour. 523—Gulf of Mexico; port of Vera Cruz. 2544—South America, east coast; Monte Video to Buenos Aires. 21—South America, Magellan strait; second narrows to cape Pillar. 660—Central America; Corinto harbour. 2462—Alaska; Windham bay to Icy cape. 1500—Alaska; Kadiak island to Seguam island. 759*a*—Madagascar; cape St. Andrew to Bevato island. 758—Madagascar, northern portion. 66*a*, *b*, *c*—India; Maldive islands. 859—Bay of Bengal; Mutlah river to Elephant point. 942*a*—Eastern archipelago, eastern portion. 2575—Celebes sea, eastern part. 1961—China; Pescadores islands. 1601 — China, north-east coast; Wusung river. 2432—Russian Tartary; Tumen Ula to Strelok bay. 2650—Russian Tartary; strait of Tartary. 2185—New Zealand; Nelson anchorages. 988—Pacific ocean; Atolls in the Marshall group.

These charts are issued by Mr. J. D. Potter, Admiralty Chart Agent, 145, Minories.

General Notes.

Iron and Steel Institute.—The Autumn Meeting of the Iron and Steel Institute will be held at Barrow-in Furness, on Tuesday, Wednesday, Thursday and Friday, September 1st, 2nd, 3rd and 4th next. The President (Andrew Carnegie, LL.D.) will deliver a short address, after which papers will be read. Among the excursions announced are visits to the works of the Barrow Hæmatite Steel Company, Ltd.; to the Askam blast furnaces and the Hodbarrow mines and sea-wall; to the naval construction works of Messrs. Vickers, Sons and Maxim; to the works of the Furness Railway Company, to Roamhead Mines and Lonsdale Blast Furnaces; to the Docks of the Furness Railway Company, &c.

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FRIDAY, AUGUST 14, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

PRIZE FOR A DUST-ARRESTING RESPIRATOR.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Prize of a Gold Medal, or Twenty Pounds, for the best Dust-Arresting Respirator for use in dusty processes, and in dangerous trades.

The Council are well aware that for many years past the necessity for such an apparatus has been recognised. As far back as 1822 the Society awarded its Gold Medal to Mr. J. H. Abraham, of Sheffield, for a Magnetic Guard to protect persons employed in dry grinding. The apparatus described in the Society's "Transactions" (Vol. 40, 1822, page 135) includes a Respirator to cover the mouth and nose. This Respirator was fitted with magnets, for the purpose of arresting the fine particles of steel thrown off in the process of pointing needles, and in other processes of dry grinding. Although the invention was greatly appreciated at the time, it appears never to have come into practical use, the main objection to it having been, it is believed, raised by the workpeople themselves, who feared that the lessened risk attached to their employment would lower their wages. Similar considerations have, it is believed, stood in the way of the introduction of various appliances intended to limit the risks associated with all trades in which the workpeople breathe a dusty atmosphere. The Council however, think that such considerations are likely to have less weight at the present time, and they hope that the offer of a prize may draw the attention of inventors to the matter, so that it may result in the production of some suitable piece of apparatus, despite the difficulties with which the solution of the problem is surrounded.

The apparatus will be required to fulfil the following conditions:

(1.) It must be light and simple in construction.

(2.) It should be inexpensive, so as to admit of frequent renewal of the filtering medium or of the Respirator as a whole; or alternatively it should be of such construction that it can be readily cleaned.

(3.) It should allow no air to enter by the nostrils or mouth except through the filtering medium.

(4.) It should not permit expired air to be rebreathed.

(5.) The filtering medium, though it should be effective in arresting dust particles, should not offer such resistance as to impede respiration when worn for some hours under the actual conditions of work.

(6.) It is desirable that it should be as little unsightly as possible.

It should be noted that the prize is offered for a Respirator intended merely to arrest dust, and not for a chemical Respirator designed to arrest poisonous fumes. The applications of such chemical Respirators are more limited, and there are special requirements connected with them. The Council have, therefore, preferred to limit the range of their present offer to the simpler and more important cases of dust, either dust of all kinds or of some special character, *e.g.*, iron or steel.

Inventors intending to compete should send in specimens of their inventions not later than 31st December, 1903, to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C. Such specimens must be accompanied by full descriptions, and in cases in which the apparatus has been put into actual use, the experience of such use should be given.

Competitors intending to patent their inventions should be careful to obtain protection, as the Council of the Society cannot undertake any responsibility as regards the secrecy of the whole, or of any part, of an invention submitted to them.

The Prize will be awarded on the report of judges appointed by the Council.

The Competition is not limited to British subjects.

The Council reserve to themselves the right of withholding the Prize, of extending the time for sending in, or of awarding a smaller Prize or smaller Prizes.

Proceedings of the Society.

CANTOR LECTURES.

HERTZIAN WAVE TELEGRAPHY.*

By Dr. J. A. Fleming, F.R.S.

Lecture IV.—Delivered March 23rd, 1903.

Hertzian Wave Telegraphy.

In this last lecture I propose to consider some of the questions connected with practical Hertzian wave telegraphy.

It may be observed at the outset that the difficulty of dealing with the subject as freely as many desire is that Hertzian wave telegraphy is no longer merely a subject of scientific investigation, but has developed into a business, and involves therefore other considerations than the simple advancement of scientific knowledge.

We can, however, discuss in a general manner some of the scientific problems which present themselves for solution. The first of these is the independence of communication between stations. It is desirable, at the outset, to clear up a little misunderstanding. There is a great difference between preventing the reception of communication when it is not desired by the recipient, and preventing it when it is the object of the latter to overhear if he can. I therefore think it necessary to distinguish between isolation and overhearing. I say that a station is *isolated* when it is not affected by Hertzian waves other than those it desires to receive, but that a station *overhears* when it can, if it chooses, pick up communications not intended for it, or cannot help receiving them against its will.

This distinction is a perfectly fair one. Any telegraph or telephone wire can be tapped, if it is desired, but unless there is some fault on the line, no station will receive a message against its desires. Moreover, it may be noted that there are penalties attaching to tapping a telegraph wire, and at present there are none connected with the misappropriation of an æther wave.

We shall therefore consider in the first place the methods so far proposed for preventing any given receiver from being affected by Hertzian waves sent out from other stations, except that or those from which it is desired to receive them. The first method is that which has been called the method of *electrical syntony*, and consists in adjusting the electrical capacity and inductance of the various open and closed circuits of the receiving and transmitting stations to be put in communication, so that they have the same electrical time-period.*

In Cantor lectures on electrical oscillations and electric waves, I discussed at length the conditions under which powerful electrical oscillations can be set up in a circuit. It was there shown that every electric circuit having capacity and inductance, has a particular or natural time-period of electrical oscillation depending on the numerical product of these quantities, and that to accumulate powerful electrical oscillations in it, the electromotive impulses on it must be delivered at this rate. Illustrations were drawn from mechanics, such as the examples furnished by vibrating pendulums and springs, and from acoustics, as illustrated by the phenomena of resonance, to show that small or feeble blows or impulses delivered at the proper time intervals have a cumulative effect in setting up vibrations in a body capable of oscillation. It is a familiar fact that if we time our blows we can achieve that which no single blow, however powerful, can accomplish in throwing into vibration a body such as a pendulum, which is capable of oscillation under the action of a restoring force. Precisely the same is true of an electric circuit. We have already seen that the receiving aerial has an alternating electromotive force set up in it by the impact of the successive electric waves sent out from the transmitter. It must, however, be remembered that the transmitter sends out a series of trains of waves, not by any means a continuous train, but one cut up into groups of probably ten to fifty waves, each separated by intervals of silence long compared with the duration of a single train of waves.

If, however, by a suitable adjustment of capacity and inductance we make the natural time-period of oscillation of the receiving aerial circuits agree with those of the transmitting aerial, within certain limits the former will only be receptive for waves of the frequency sent

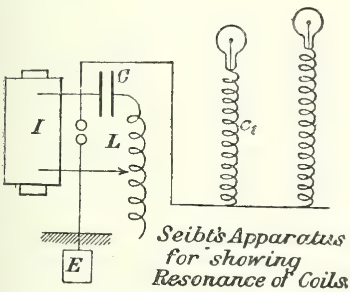
* The blocks illustrating these lectures have been kindly lent by the Proprietors of *Engineering*.

* The capacity of an electrical circuit corresponds to the elastic pliability, or what is commonly called the elasticity, of a material substance, and the inductance to mass or inertia. Hence capacity and inductance are qualities of an electric circuit which are analogous to the elasticity and inertia of such a body as a heavy spring.

out by the transmitter. It is quite easy to illustrate this principle by numerous experiments.

I have before me an apparatus devised by Dr. George Seibt, for showing in an interesting manner the syntonisation or tuning of two electric circuits. We have here two bobbins, C_1 and C_2 (Fig. 46), each consisting of one layer of insulated wire wound on a wooden rod. Each of these bobbins has a certain electrical capacity with respect to the earth when considered as an insulated conductor, and it has a certain inductance. If, therefore, electromotive impulses are applied to one end of the bobbin at regular intervals, electrical oscillations will be set up in it, and as already explained, if these are timed at a certain rate, the bobbin will act like a closed organ pipe to air impulses, and oscillations of potential will be accumulated at the opposite end which have much greater amplitude than the impressed oscillations at the end of which they are applied. We can make the existence of these augmented oscillations of potential evident by attaching to one end of the bobbin a vacuum tube which will be illuminated thereby, or by terminating it by a pointed piece of wire, so that an electrical brush can be formed at the point, if the potential variations have sufficient amplitude. We have here also another closed oscillation circuit consisting of two Leyden jars and a variable inductance coil, and a pair of spark balls which are connected to an induction coil. In this manner, we can set up oscillations in the discharge circuit of these Leyden jars, and we can vary the time-period by altering the inductance and the capacity. If we denote the capacity of the jars in microfarads by the letter C and the inductance in centimeters of the discharge circuit of the jars by the letter L, it can then be shown that the number of oscillations per second denoted by n is given by the expression:—*

FIG. 46.



$$n = \frac{5{,}000{,}000}{\sqrt{C\,L}}$$

If now we adjust the Leyden jar circuit to a particular rate of oscillation, we have between the terminals of the jar or condenser an alternating difference of potential. If we connect one side of the jars to the earth and the other side to the foot of one of the spirals or bobbins above described, you see that the vacuum tube at the other end is not at the present moment luminous. When, however, we adjust the inductance in the discharge circuit of the jar to a certain value, to make the frequency of the condenser oscillations agree with the natural time-period of the bobbin terminated by the vacuum tube, this latter at once lights up brilliantly. Let us then connect both these bobbins at the same time to the discharge circuit of the Leyden jar, and we shall find that we can make an adjustment of the inductance of that circuit, such that either of the bobbins at pleasure can be made to respond and be set in electrical vibration, as shown by the illumination of the vacuum tube at its upper end, or by an electrical brush being formed at the terminal. In making this adjustment of inductance, I am *tuning*, as it is called, the Leyden jar discharge circuit to the resonating bobbin. A very small variation of the inductance of the jar circuit causes the vacuum tube to change in luminosity. If, however, the natural time-periods of these bobbins do not lie very far apart, then more or less luminosity may make its appearance in both the vacuum tubes. Supposing, therefore, that I connect to the oscillating circuit of the jar a number of bobbins having different time-periods of oscillation, like organ pipes, and supply them all with one common alternating electromotive force, those bobbins, whose natural time-period is very different to that of the oscillating circuit or impressed electromotive force, will not respond, but those bobbins of which the natural time-period lies near to, even if not quite exactly the same as, that of the impressed electromotive force, will give some evidence of being set in oscillation. A very violent electromotive force will cause them all to respond to some slight extent, no matter

* See Lectures on "Electrical Oscillations and Electric Waves," delivered before the Society of Arts, Nov. 26th, Dec. 4th, 10th, 17th, 1900. Lecture I., p. 12 of reprint.

whether the period of that impulse is tuned to their own particular period precisely or not.

At this point questions arise of great practical importance. A matter which has been in dispute in connection with practical Hertzian wave telegraphy is how far this electrical tuning is a sufficient solution of the practical problem of isolation. It is not denied that experiments such as those made with Seibt's apparatus can be shown on a small scale, and on a still larger scale Mr. Marconi gave to the author in September, 1900, a demonstration in practical telegraphic work of sending two independent Hertzian wave messages and receiving them on two independent receivers attached to the same aerial. The results of this experiment were described in a letter to the *Times* on October 4th, 1900, which has often been quoted by Mr. Marconi and others.

Since that date much experience has been gained and large power stations erected, and a statement has been frequently made that syntony is no protection against interference when one of the stations is sending out very powerful waves. The contention has been raised that large power stations producing electric waves will therefore play havoc with Hertzian wave telegraphy on a smaller scale, such as the ship to shore and intermarine communication. Under these circumstances, it appeared to the author important to subject the matter to a special test, and Mr. Marconi therefore offered to give a demonstration with this object, in support of the opinion that he has expressed that waves from his power stations do not interfere with the working of his ship installations. This matter is vital to the whole question of practical Hertzian wave telegraphy, for the ship to shore communication is of stupendous importance, and if Mr. Marconi had done nothing else except render this possible and effective, he would have earned, as he has done, the gratitude of humanity for all time. Accordingly, the author took an opportunity of making some careful tests to decide whether the powerful waves sent out from a station such as Poldhu, did or did not affect the exchange of messages between ships and shore stations in proximity, equipped with Marconi apparatus of a suitable type.

These experiments were carried out on the 18th March last, at Poldhu, in Cornwall, and a programme was arranged by the author of the following kind. Close to the Poldhu station is an isolated mast, which was equipped by Mr. Marconi with a Hertzian wave apparatus similar to that placed on ships. Six miles from Poldhu is the Lizard Marconi station, with which ships proceeding up or down the English Channel communicate. It was arranged that a series of secret messages, some of them in cipher, should be delivered simultaneously at certain known times, both to the power station at Poldhu and to the small adjacent ship station, and it was arranged that these messages should be sent off simultaneously, the operators being kept in ignorance up to the moment of sending, as to the nature of the messages. At the Lizard, Mr. Marconi connected receiving instruments to the aerial; one of them tuned to the waves proceeding from the power station at Poldhu, and the other to those proceeding from the small ship station. At the appointed time, these two sets of messages were received simultaneously in the presence of the author, each message being printed down independently on its own receiver, and Mr. Marconi read off and interpreted all these messages perfectly correctly, not having known before the message that was sent. In addition to this, precautions were taken to prove that the power station at Poldhu was really emitting waves of great power, and not being made to sing small for the occasion. To assist in proving this, the messages sent out from the power station were also received at a station at Poole, 200 miles away, and the assistant there was instructed to telegraph back these messages by wire as soon as he received them. These messages came back perfectly correct, thus demonstrating that the power station was sending out power waves. The whole programme was carried out with the greatest care to avoid any mistakes on the part of the assistants, and provided a confirmation of the truth of Mr. Marconi's assertion, that the waves from one of his power stations, such as Poldhu, do not in the least degree interfere with the transmission and reception of messages between ship and shore, effected by means of certain forms of Marconi apparatus. This complete independence of transmission, however, is entirely due to the employment of a receiving circuit of a certain type in Mr. Marconi's receivers. It does not at all follow that a receiving circuit of any kind, even a Marconi receiver not especially arranged, set up in proximity to a power station would not be affected.

It must be noted, however, that although the fact that electric circuits have a natural time period of oscillation of their own, is a scientific

principle which has a fundamental importance in connection with syntonic Hertzian wave telegraphy, it is not in itself alone in every respect an entire solution of the practical problem. The degree to which it is a solution depends partly upon the nature of the detecting device, or kumascope, which we are employing. The coherer or Branly filings tube has the peculiarity that its passage from a non-conductive to a conductive condition follows immediately when the difference of potential between its ends is made sufficiently great. In other words, if the tube is acted upon by a sufficient electromotive force, it is not necessary that electromotive force should be repeated at intervals to make this particular form of kumascope responsive. Again, if we consider the nature of the oscillations which are sent out from any transmitting aerial, we find that each group of oscillations corresponding to a single spark, consists of waves gradually decreasing in amplitude. In other words, the first wave of the group is the strongest, and the decay in amplitude is often very rapid. Supposing, then, we construct a simple receiver consisting of an aerial having in its circuit inserted a sensitive Branly filings tube. Such a receiver is almost entirely non-syntonic; that is to say, it is affected by any wave passing over it which is sufficiently powerful. We may look upon it that if the first wave of the series is sufficiently powerful to affect the kumascope, the conductive change takes place whether or not the first wave is followed by others. Accordingly, it is perfectly certain that if a transmitter is sending out trains of waves of any period, a simple combination of coherer and aerial will be influenced if it is placed near enough to the transmitter. Mr. Marconi has pointed out that certain types of kumascope, as for instance the Italian navy kumascope, are not well adapted for syntonic reception. On the other hand, it is possible to combine a kumascope of a certain type with a receiving aerial and other circuits, in such a manner that it shall not respond at all unless those waves have very nearly a time-period of a certain value.

At this stage, it may be perhaps well to explain a little in detail what is meant by an easily responsive circuit, and, on the other hand, by an irresponsive circuit, or, as I prefer to call it, a *stiff* circuit. Supposing that we consider an aerial consisting of a simple straight wire having small capacity and small inductance, such a circuit admits of being sent into electrical oscillation, not only by waves of its own natural time period, but by the sudden application of any violent electromotive impulse. If, on the other hand, we bestow upon the circuit in any way considerable inductance, we then obtain what may be called a stiff or irresponsive circuit, which is one in which electrical oscillations can be accumulated only by the prolonged action of impulses tuned to a particular period.

A mechanical analogue of this difference may be found in considering the different behaviour of elastic bodies to mechanical blows. Take for instance a piece of elastic steel, and fix the bottom end in a vice. The steel strip may be thrown into vibration by deflecting the upper end. It has, however, a very small mass, and therefore any violent blow or blows, even although not repeated, will set it in oscillation. If, however, we add mass to it by fixing at the other end a heavy weight, such as a ball of lead, and at the same time make the spring stiffer, we have an arrangement which is capable of being sent into considerable oscillation only by the action of a series of impulses or blows which are timed at a particular rate.

Returning then to the electrical problem, we see that in order to preserve a kumascope or wave detector from being operated on by any vagrant wave or waves, having a period very different to an assigned period, it must be associated with an electrical circuit of the kind I have called a stiff circuit.

We will now consider the manner in which the problem has been practically attacked by Mr. Marconi, Dr. Slaby, Sir Oliver Lodge, and others, who have invented forms of receiver and transmitter which are syntonic or sympathetic to one another.

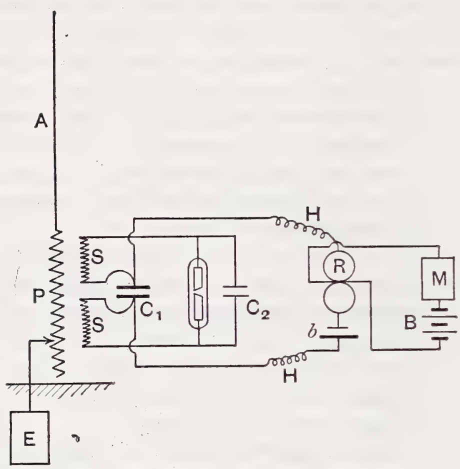
Some of the methods which Mr. Marconi has devised for the achievement of syntonic wireless telegraphy were fully described by him in a paper read before the Society of Arts on May 17th, 1901.*

On referring to his paper, it will be seen that in one form his transmitter consists of an aerial near the base of which is inserted the secondary circuit of an oscillation transformer. One end of this secondary circuit is attached to the aerial, and the other end is connected to the earth through a variable inductance coil. The primary circuit of this oscillation transformer is connected in series with a condenser, con-

* See *Society of Arts Journal*, vol. 49, p. 505. "Syntonic Wireless Telegraphy," by G. Marconi.

sisting of a battery of Leyden jars, and the two together are connected across to the spark balls which close the secondary circuit of an induction coil, having the usual make and break key in the primary circuit. Mr. Marconi so adjusts the inductance of the aerial and the capacity of the condenser or battery of Leyden jars, that the two circuits, consisting respectively of this battery of Leyden jars and the primary circuit of the transformer, and on the other hand of the capacity of the aerial and the inductance in series with it, and that of the secondary circuit of the transformer, have the same time-period. In other words, these two inductive circuits are tuned together. At the receiving end, the aerial is connected

Fig. 47.



Marconi Syntonic Receiver.

in series with a variable inductance, and with the primary circuit of another oscillation transformer, the second terminal of which is connected to the earth. The secondary circuit of this last oscillation transformer is cut in the middle, and is connected to the terminals of a small condenser. The outer terminals of this secondary circuit are connected to the metallic filings tube or other sensitive receiver, and to a small condenser in parallel with it. (See Fig. 47.) The terminals of the condenser which is inserted in the middle of the secondary circuit of the oscillation transformer, are connected through two small inductance coils with a relay and a single cell. This relay in turn actuates a Morse printer by means of a local battery. The two circuits of the oscillation transformer are tuned or syntonised to one another, and also to the similar circuit of the transmitting arrangement. When this is the case, the transmitter affects the co-resonant receiving arrangement, but will not affect any non-syntonic similar arrangement, unless it is within a certain minimum range of distance. Owing to the inductance of the oscillation transformer forming part of the receiving arrangements, the receiving circuit is, as I have called it, very stiff or irresponsive; the sensitive tube is not acted upon in virtue merely of the impact of the single wave against the aerial, but it needs repeated or accumulated effects of a great many waves coming in proper time to break down the coherer and cause the recording mechanism to act. An inspection of the diagram will show that as soon as the secondary electromotive force in the small oscillation transformer or jigger of the receiving instrument is of sufficient amplitude to break down the resistance of the coherer, the local cell in circuit with the relay can send a current through it and cause the relay to act, and in turn make the associated telegraph instrument record or sound.

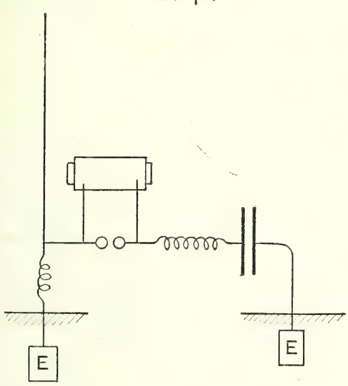
Mr. Marconi described in the above mentioned paper some other arrangements for achieving the same result, but those mentioned all depend for their operation upon the construction of a receiving circuit on which the time-period of electrical oscillations is identical with that of a transmitting arrangement. By this means he showed experiments during the reading of his paper, illustrating the fact that two pairs of transmitting and receiving arrangements could be so syntonised that each receiver responded only to its particular transmitter and not to the other.

With arrangements of substantially the same nature, he made experiments in the autumn of 1900, between Niton, in the Isle of Wight, and Poole, near Bournemouth, a distance of about thirty miles, in which independent messages were sent and received on the same aerial.

Dr. Slaby and Count von Arco, working in Germany, have followed very much on the same lines as Mr. Marconi, though with appliances of a somewhat different nature. As constructed by the General Electric Company of Berlin, the Slaby-Arco syntonic system of Hertzian telegraphy, is arranged in one form as follows:—The transmitter consists of a vertical rod like a lightning conductor, say 100 or 150 feet in height. At a point six or nine feet above the ground, a connection is made to a spark ball (see Fig. 48), and the

corresponding ball is connected, through a variable inductance, with one terminal of a condenser, the other terminal of which is connected to the earth. The two spark balls are connected to an induction coil or alternating current transformer, and by variation of the inductance and capacity, the frequency is so arranged that the wave length corresponding to it is equal to four times the length of that portion of the aerial which is above the spark ball connection. The method by which this tuning is achieved is to insert in the portion or the aerial below the spark balls between it and the earth a hot wire ammeter of some form. It has already been shown that in the case of such an earthed aerial, when electrical oscillations are set up in it, there is a potential node

Fig. 48.

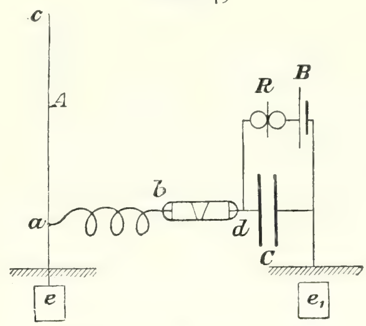


Slaby Syntonic Transmitter.

at the earth, and a potential antinode or loop at the summit, if it is vibrating in its fundamental manner; also there is a node of current at the summit of the aerial and an antinode at the base. This amounts to saying that the amplitude of the potential vibrations is greatest at the top end of the aerial, and the amplitude of the current vibrations is greatest at the bottom or earthed end. Accordingly, the inductance and capacity of the lateral branch of the transmitter is altered until the hot wire ammeter in the base of the aerial shows the largest possible current.

The corresponding receiver is constructed in a very similar manner. A lightning conductor or long vertical rod of the same height as the transmitting aerial, is set up at the receiving station, and at a point six or nine feet from the ground, a circuit is taken off, consisting of a wire loosely coiled in a spiral, the length of which is nearly equal to, although a little shorter than, the height of a vertical wire above the point of connection. (See Fig. 49.) The outer end of this loose spiral is connected to one terminal of the coherer tube, and the other terminal of the coherer is connected to the earth through a condenser of rather large capacity. The terminals of this last condenser are short circuited by a relay and a single cell.

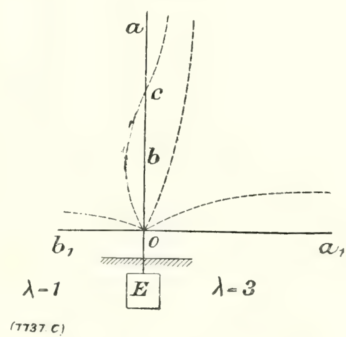
Fig. 49.



Slaby Syntonic Receiver.

When the adjustments are properly made the receiver responds only to waves coming from its own syntonised or tuned transmitter. In this case the length of the receiving aerial above the point of junction with the coherer circuit is one quarter the length of the wave. A variation of the above arrangements consists in making this lateral circuit equal in length to one-half of a wave, and connecting

Fig 50.



Slaby Multiple Receiving Aerial.

the coherer to its centre through a condenser, to the earth. The outer end of this lateral circuit is also connected to the earth.*

Dr. Slaby claims that his arrangement is not affected by atmospheric electricity, and that the complete and direct earthing of the aerial, and also in the second arrangement, of

* See German Patent Specifications, Class 21a, No. 7452, 1900; also No. 8087, of 1901.

the receiver of the outer end of the lateral conductor, conduces to preserve the receiver immune from any electrical disturbances except those having a period to which it is tuned.

A method has also been arranged by him for receiving on the same aerial two messages from different transmitting stations simultaneously. In this case, two lateral wires are connected to the receiving aerial of different lengths, and to the outer end of each of these is connected a coherer tube, the other end of which is earthed through a condenser. (See Fig. 50.) One of these lateral wires is made equal or nearly equal in length to the aerial, and the other is made longer to fulfil the following condition* :—If we call H the height of the receiving aerial, above point of junction of the lateral wires, then the length of one lateral wire is made equal to H, and the height of the aerial is adjusted to be equal to one quarter of the wave length of one incident wave. The other lateral wire may then be made of a length equal to one-third of H, and it will then respond to the first odd harmonic of that wave, of which the fundamental is in syntony with the vertical wire. By suitably choosing the relation between the wave lengths of the two transmitting stations, it is possible to receive in this manner two different messages at the same time on the same aerial. Subsequently to the date of the above-mentioned demonstration of multiplex wireless telegraphy by Mr. Marconi, an exhibition of a similar nature was given by Professor Slaby in a lecture delivered in Berlin on December 22nd, 1900.† The arrangements of the latest form of Slaby's Mutiple Telegraphy, are, however, shown in Fig. 51, where the aerial in the centre transmits waves of two frequencies to the separate aerials on either side.

FIG. 51.

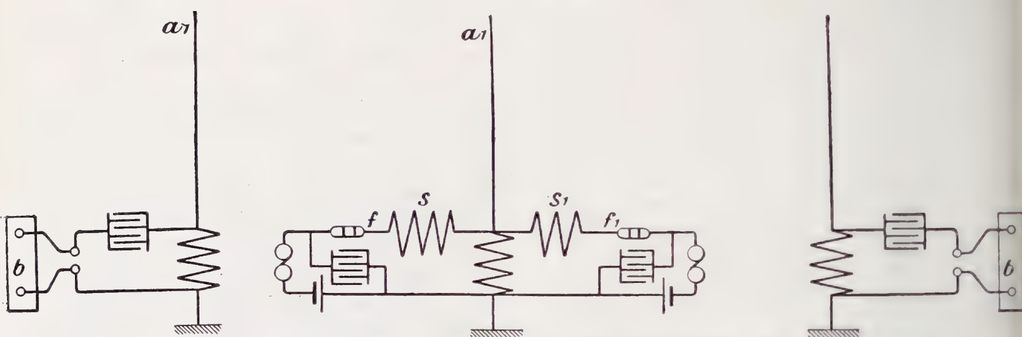


Diagram of Slaby's Multiple Telegraphy Connections (1900.)

Both the above described syntonic systems of Mr. Marconi and Dr. Slaby are "earthed" systems, but arrangements for syntonic telegraphy have been devised by Sir Oliver Lodge and Professor Braun, which are "non-earthed."

In one arrangement proposed by Sir Oliver Lodge* the receiving and transmitting aerials consist of a pair of triangular-shaped plates. The transmitting aerial comprises a spark gap arrangement and an induction coil or Tesla coil for charging these wing-shaped plates to opposite potentials, and they were then permitted to discharge across the air gap. The receiving aerial consisted of a similar pair of plates, both insulated and connected by wires with some receiving arrangement comprising a coherer.

The author is not aware, however, that these arrangements, as described, have ever been put into actual practice, and in more recent patent specifications by Sir Oliver Lodge and Dr. Muirhead a different system is adopted. According to their later methods the syntonic transmitting and receiving arrangements are as shown in Fig. 52.† On examining the diagrams it will be seen that the secondary terminals of the induction coil are, as usual, connected to a pair of spark balls, and that these spark balls are connected by a condenser and by a variable inductance. One terminal of the condenser is earthed through another condenser of larger capacity, and the remaining terminal of the first condenser is connected to an aerial. It should be borne in

* See German Patent Specification, Class 21a, No. 7498 of 1900, applied for November 9th, 1900. The above-mentioned patent is subsequent in date to Mr. Marconi's British Specification on the same subject.

† See *Electrician*, Jan. 18th, 1901, vol. 46, p. 475. Also reprint of a Paper by Prof. A. Slaby :—"Abgestimmte und mehrfache Funkentelegraphie."

* See British Specification No. 11575, 1897.

† See British Specification No. 11348, 1901.

mind in dealing with electrical oscillations that a condenser of sufficient capacity is practically a conductor, and an inductance coil of sufficient inductance is practically a non-conductor. Hence the insertion of a large capacity in the path of the aerial wire has no advantage whatever, and makes no essential difference in the arrangement. In order to obtain any powerful radiation, the length of the aerial or sky wire, as they call it, must be so adjusted that its length is one quarter the wave length corresponding to the oscillating circuit consisting of the condenser and variable inductance.

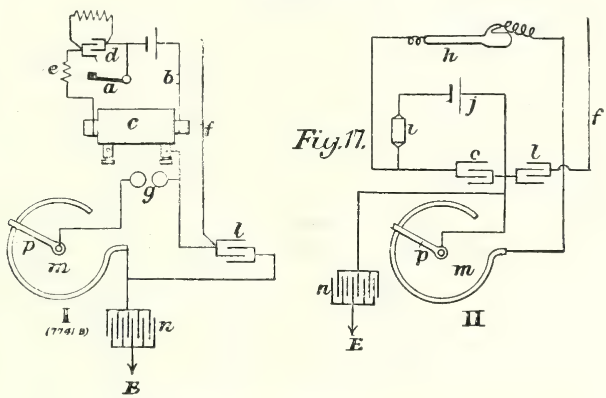
The receiving arrangement consists of a similar sky wire or aerial earthed through a condenser of large capacity, and having in the portion above this last condenser, another condenser of similar capacity. At the earthed side of this last condenser a connection is made to a resonant circuit consisting of a variable inductance and another condenser, and a sensitive metallic filings tube of the Branly type, also a portion of this resonant circuit is shunted by another consisting of a battery and telegraphic relay, as shown in the diagram. The circuit including the coherer, is tuned to its own aerial, and also to that of the transmitting circuit, and under these circumstances, trains of waves thrown off at the transmitting aerial will sympathetically affect the receiving aerial.

Professor Braun's syntonic system, the receiver and transmitter of which have been described in the two previous lectures, is also in one form a non-earthed system. Innumerable other patentees have taken out patents for devices which are modifications in some small degree of the above arrangements.

It may be well to note at this point the disadvantages of the coherer as a telegraphic kumascope in connection with proposed arrangements for the isolation of Hertzian wave stations. All the detectors of the coherer type really depend for their actuation upon their electromotive force; that is to say, upon the application to the terminals of the detector of a certain electromotive force. Although there may be no sharply defined critical electromotive force, yet nevertheless, as a matter of fact, if the electromotive force applied exceeds a certain value, then the detector passes suddenly from one state of conductivity to another. It may be of great conductivity, as in the Branly coherer, or of lesser conductivity, as in the case of the so-called anticoherers, of which the Schäfer kumascope may be taken as a type. Accordingly, when these instruments are subjected to a train of waves, each individual group of which is damped, their operation is largely governed by the fact that if the first wave or oscillation set up in the receiving circuit is powerful enough to break down the coherer, then the receiving mechanism acts, no matter whether the first impulse is followed by others or not.

In comparison with so-called coherers the magnetic kumascopes, those depending upon changes in the magnetisation of iron by electrical oscillations certainly have an advantage, because this is a process which requires the application of alternating electric currents decreasing in strength for a certain time, and it is found, therefore, that the magnetic receivers do not require to be associated with such a stiff or irresponsive resonant circuit to confine their indications to

Fig. 52.



Sir Oliver Lodge's and Dr. Muirhead's System.

oscillations or waves of one definite period, and that they lend themselves much more perfectly to the work of "tuning" or syntonising stations than do those kumascopes depending upon the contact or coherer principle.

We may then glance at the alternative solutions of the problem offered by other investigators. M. Blondel has proposed to effect the syntonisation of two stations, not by syntonising the receiver for the exceedingly high frequency oscillations of the individual electric waves, but to syntonise it for the much lower frequency corresponding to that of the intervals between the groups of waves. Thus, for instance, if an ordinary simple transmitting aerial is set up, the production of sparks between the spark balls results in the omission of short trains of waves, each of which may consist of half a dozen or more individual waves, the time of production of the whole group being very small compared with the interval between the groups. M. Blondel proposes, however, to syntonise the receiver not for the high frequency period of the waves themselves, which may be reckoned in millions per second, but for the low frequency period between the groups of waves, which is reckoned in hundreds per second. Thus, for instance, if sparks are made at the rate of fifty or a hundred per second, they can be made to actuate the telephone receiver, and so produce in the telephone a sound corresponding to a frequency of fifty or one hundred. In other words, to make a low musical note or hum. This continuous sound can be cut up by means of a key placed in the primary circuit of the transmitting arrangement, into long or short periods, and hence the letters of the alphabet signal.

M. Blondel's arrangements comprise a Mercadier's monotone telephone, and either a coherer or a particular form of vacuum tube as a kumascope. On August 16th, 1898, M. Blondel deposited with the Academy of Sciences in Paris a sealed envelope containing a description of his improvements in syntonic wireless telegraphy, which was opened on May 19th, 1900.* The arrangement of the receiving apparatus was as follows:—A single battery cell keeps a condenser charged until a kumascope connected with it is rendered conductive by the oscillations coming down an associated aerial, and under these circumstances, the condenser discharges through the telephone and causes a tick to be heard in it. If the trains of waves are at the rate of 50 or 100 per second, these small sounds run together into a musical note, and this continuous hum can be cut up into long and short spaces, in accordance with the Morse alphabet signals. The telephone must not be an ordinary telephone, capable of being influenced by any frequency, but be one which responds only to a particular note, and under these conditions, the receiving arrangement is receptive only when the trains of waves arrive at certain regular predetermined intervals, corresponding with the tone to which the telephone is sensitive.

* See *Comptes Rendus*, May 21st, 1900; or *Rapports du Congrès International d'Electricité*, Paris, 1900, p. 341.

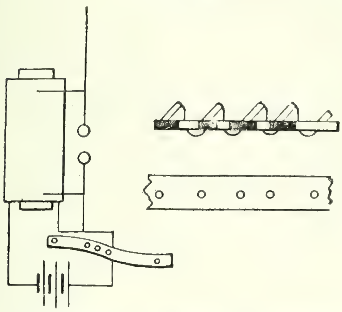
A number of more or less imperfect arrangements having the isolation of communications for their object, have been devised or patented, which are dependent upon the use of several aerials, each supposed to be responsive only to a particular frequency, and attempts have been made to solve the problem of isolation by MM. Tommasi, Jegon, Tissot, Ducretet, and others.

We may then pass on to notice the attempts that have been made to secure isolation by a plan which is not dependent on electrical syntony. One of these which has the appearance of developing into a practical solution of the problem is that due to Anders Bull.* In the first arrangements proposed by this inventor, a receiver is constructed which is not capable of being acted upon merely by a single wave or train of waves, or even a regularly spaced train of electric waves, but only by a group of wave trains which are separated from one another by certain unequal predetermined intervals of time. Thus, for instance, to take a simple instance, the transmitting arrangements are so devised as to send out groups of electric waves, these wave trains following one another at time intervals which may be represented by the numbers 1, 3, and 5; that is to say, the interval which elapses between the second and third is three times that between the first, and the interval between the fourth and fifth is five times that between the first two. That is achieved by making five electric oscillary sparks with a transmitter of the ordinary kind, the intervals between which are settled by the intervals between holes punched upon strips of paper, like that used in a Wheatstone automatic telegraphic instrument (see Fig. 53). It will easily be understood that by a device of this kind groups of sparks can be made, say, five sparks rapidly succeeding each other, but not at equal intervals of time. One such group constitutes the Morse dot, and two

* See the *Electrician*, vol. 46, p. 573, Feb. 8th, 1901.

or three such groups succeeding one another very quickly constitute the Morse dash. These waves, on arriving at the receiving station, are caused to actuate a punching arrangement by the intermediation of a coherer or other kumascope, and to punch upon a uniformly moving strip of paper, holes which are at intervals of time corresponding to the intervals between the sparks at the transmitting station. This

FIG. 53.



ANDERS BULL SELECTOR SYSTEM.

strip of paper then passes through another telegraphic instrument, which is so constructed that it prints upon another strip, a dot or a dash, according to the disposition of the holes on the first strip. Accordingly, taken as a whole, the receiving arrangement is not capable of being influenced so as to print a telegraphic sign, except by the operation of a series of wave trains succeeding one another at certain assigned intervals of time.

An improvement has been lately described by the same inventor,* in which the apparatus used, although more complicated, performs the same functions. At each station two instruments have to be employed; at the transmitting station, one to effect the conversion of Morse signals into the properly arranged series of wave trains, and at the receiving station an instrument to effect the re-conversion of the series of wave trains into the Morse signals. These are called respectively the dispenser and the collector. The details of the arrangements are somewhat complicated, and can only be described by the aid of numerous detailed drawings, but the inventor states that he has been able to carry on Hertzian wave telegraphy by means of these arrangements for short distances. Moreover, the method lends itself to an arrangement of multiplex telegraphy, by sending out from different transmitters signals which are based upon different arrangements of time intervals between the electric wave trains. Although this method may succeed in preventing a receiving arrangement from being influenced by vagrant waves or waves not intended for it, yet an objection which arises is that there is nothing to prevent anyone from intercepting these wave trains, and, with a little skill, interpreting their meaning. Thus, if the record were received in the ordinary way on a simple receiver, corresponding to a Morse dot, would be printed five dots at unequal intervals, and corresponding to a Morse dash would be printed two such sets of five dots. A little skill would then enable an operator to interpret these arbitrary signals. On the other hand, the inventor asserts that he can overcome this difficulty by making intervals of time between the impulses in the series so long that the latter become longer than the intervals between each of the series of waves which are despatched in continous succession when the key is pressed for a dash. In this case, when telegraphing, the series of dots would overlap and intermingle with each other in a way which would make the record unintelligible if received in the usual manner, but would be perfectly legible if received and interpreted by a receiver adapted for the purpose.

Another way of obliterating the record as far as outsiders are concerned, is to interpolate between the groups of signals an irregular series of dots, *i.e.*, of wave trains, which would affect an ordinary coherer, and so make an unintelligible record on an ordinary receiver, but these dots are not received or picked up by the appropriate selecting instrument used in the Anders Bull system.

The matter most interesting to the public at the present time is the long distance telegraphy by Hertzian waves, to the accomplishment of which Mr. Marconi has devoted himself with so much energy and success of late years. Everyone, except, perhaps, those whose interests may be threatened by his achievements, must accord their hearty admiration of the indomitable perseverance and courage which he has shown in overcoming the immense difficulties which have presented themselves. Five years ago he was engaged in sending signals from Alum Bay, in the Isle of Wight, to Bournemouth, a distance of twelve or fourteen miles, and to-day he has conquered twice that number of hundred miles, and succeeded in sending, not merely signals, but long messages of all descriptions over three thousand miles across the Atlantic. Critics

* See *Electrician*, vol. I, p. 418, Jan. 2nd, 1903.

there are in abundance who declare that the process can never become a commercial one, that it will destroy short distance Hertzian telegraphy, or that the multiplication of long distance stations will end in the annhilation of all Hertzian wave telegraphy. No one, however, can contemplate the history of any development of applied science without seriously taking to heart the lesson that the obstacles which arise and which prove serious in any engineering undertaking, are never those which occur to armchair critics. Sometimes the apparently impossible proves the most easy to accomplish, whilst difficulties of a formidable nature often spring up where least expected.

The long distance transmission is a matter of peculiar interest to me, because I was, at an early stage in connection with it, invited to render Mr. Marconi some assistance in the matter.* The particular work entrusted to me was that of planning the electrical engineering arrangements of the first power station erected for the production of electric waves for long distance Hertzian wave telegraphy at Poldhu, in Cornwall. When Mr. Marconi returned from the United States, in the early part of 1900, he had arrived at the conclusion that the time had come for a serious attempt to accomplish wireless telegraphy across the Atlantic. Up to that date, the project had been an inventors' dream, much discussed, long depicted, but never before practically taken in hand. The only appliances, moreover, which had been used for creating Hertzian waves, were induction coils or small transformers, and the greatest distance covered, even by Mr. Marconi himself, had been something like 150 miles over sea. Accordingly, to grapple with the difficulty of creating an electric wave capable of making itself felt at a distance of 3,000 miles, even with the delicate receiving appliances invented by Mr. Marconi, seemed to require the means of producing at least four hundred times the wave-energy that had been previously employed. The author was therefore requested to prepare plans and specifications for an electric generating plant for this purpose, which would enable electrical oscillations to be set up in an aerial on a scale never before accomplished.

This work involved not merely the ordinary experience of an electrical engineer, but also the careful consideration of many new problems, and the construction of devices not before used. Every step had to be made secure by laboratory experiments before the responsibility could be incurred of advising on the nature of the machinery and appliances to be ordered. Many months in the year 1901 were thus occupied by the author in making small scale experiments in London, and in superintendence of large scale experiments at the site of the first power station at Poldhu, near Mullion, in Cornwall, before the plant was erected, and any attempt was made by Mr. Marconi to commence actual telegraphic experiments. As this work is of a highly confidential nature, it is obviously impossible to enter into the details of the arrangements, either as made by me in the first instance, or as they have been subsequently modified by Mr. Marconi. The design of the aerial and many of the working appliances, are entirely due to Mr. Marconi, but as a final result a power plant was erected for the production of Hertzian waves on a scale never before attempted. The utilisation of 50 or 100 horse-power for electric wave production has involved dealing with many difficult problems in electrical engineering, not only in novelty of general arrangement, but also in details.

In the initial experiments with this machinery, and in its first working, there was very considerable risk, owing to its novel and dangerous nature, but throughout the whole of the work from the very beginning, no accident of any kind has taken place, so great have been the precautions taken. The only thing of the nature of a mishap was the collapse of a ring of tall masts erected in the first place, to sustain the aerial wires, but which have now been replaced by four substantial timber towers 213 feet in height, placed at the corners of a square 200 feet in length. These four towers sustain a conical arrangement of insulated wires which can be used in sections, and which constitute the transmitting radiator or receiving aerial, as the case may be. Each of these wires is 200 feet in length, and formed of bare stranded wire.

At the outset, there was much uncertainty as to the effect of the curvature of the earth on the propagation of the Hertzian wave over a distance of many hundreds of miles. In the case of the Atlantic transmission between the station at Poldhu, in Cornwall, and that at Cape Cod, in Massachusetts, U.S.A., we have two stations separated by about 45 degrees of longitude on a great circle, or one eighth part of the circumference of the world. In this

* See Mr. Marconi's Friday Evening Discourse at the Royal Institution, June 13th, 1902. See also the *Electrician*, vol. 49, p. 390.

case, the versine of the arc or height of the sea at the halfway point above the straight line or chord, joining the two places, is 300 miles.

This question has lately attracted the attention of several eminent mathematical physicists. The extent to which a free wave propagated in a medium bends round any object, or is diffracted, depends on the relation between the length of the wave, and the size of the object. Thus, for instance, an object the size of an orange, held just in front of the mouth, does not perceptibly interfere with the propagation of the waves produced by the speaking or singing voice, because these are from two to six feet in length, but if arrangements are made by means of a Galton whistle, to produce air waves half an inch in length, then an obstacle the size of an orange causes a very distinct acoustic shadow. The same thing is true of waves in the æther. The amount of bending of light waves round material objects, is exceedingly small, because the average length of light waves is about one fifty-thousand part of an inch. In the case of Hertzian wave telegraphy, we are dealing with æther waves many hundreds of feet in length, and the waves sent out from Poldhu have a wave length of a thousand feet or more, say one-fifth to one quarter of a mile. The distance, therefore, between Poldhu and Cape Cod, is only at most about twelve thousand wave lengths, and stands in the same relation to the length of the Hertzian wave used as does a body, the diameter of a pea, to the wave length of yellow light. There is unquestionably a large amount of diffraction or bending of this electric wave round the earth, and proportionately speaking it is larger than in the case of light waves, incident on objects of the same relative size.

Quite recently Mr. H. M. Macdonald (see *Proc. Roy. Soc.*, Lond., vol. 71, p. 251) has submitted the problem to calculation, and his work seemed to show that the power required to send given electric waves 3,000 miles along a meridian of the earth would be greater than would be required to send them over the same distance if the sea surface were flat in the ratio of 10 to 3. Hence the rotundity of the earth does introduce a very important reduction factor, although it does not inhibit the transmission. Mr. Macdonald's mathematical argument has, however, been criticised by Lord Rayleigh and M. H. Poincaré. (See *Proc. Roy. Soc.*, vol. 72, p. 40, 1903.)

The accomplishment of very long distances by Hertzian wave telegraphy is, however, not merely a question of power. Having regard, however, to the possibility that the propagation which takes place in Hertzian wave telegraphy is not that of a free wave in space, but the transmission of that which I called in the first lecture, a semi-loop of electric strain with its feet tethered to the earth, I think it is quite possible that if it were worth while to make the attempt, an æther disturbance could be made in England sufficiently powerful to be felt in New Zealand.

Leaving, however, these hypothetical questions and matters of pure conjecture, we may consider some of the facts which have resulted from Mr. Marconi's long distance experiments. One of the most interesting of these is the effect of daylight upon the wave propagation. In one of his voyages across the Atlantic, when receiving signals from Poldhu on board the s.s. *Philadelphia*, he noticed that the signals were received by night when they could not be detected by day.* In these experiments, Mr. Marconi instructed his assistants at Poldhu to send signals at a certain rate from 12 to 1 a.m., from 6 to 7 a.m., from 12 to 1 p.m., and 6 to 7 p.m., Greenwich mean time, every day for a week. He states that on board the *Philadelphia* he did not notice any apparent difference between the signals received in the day and those received at night until the vessel had reached a distance of 500 statute miles from Poldhu. At distances of over 700 miles, the signals transmitted during the day failed entirely, while those sent at night remained quite strong up to 1,551 miles, and were clearly decipherable up to a distance of 2,099 miles from Poldhu. Mr. Marconi also noted that at distances of over 700 miles, the signals at 6 a.m. in the week between Feb. 23rd and March 1st, were quite clear and distinct, whereas by 7 a.m. they had become weak almost to total disappearance. This fact led him at first to conclude that the cause of the weakening was due to the action of the daylight upon the transmitting aerial, and that, as the sun rose over Poldhu, so the wave energy radiated, diminished, and he suggests as an explanation the known fact of the dissipating action of light upon a negative charge.

Although the facts seem to support this view, another explanation may be suggested. It has been shown by Professor J. J. Thomson that

* See "Proc. Roy. Soc.," June 12th, 1902. A Note on the Effect of Daylight upon the Propagation of Electro-magnetic Impulses over Long Distances, by G. Marconi.

gaseous ions or electrons can absorb the energy of an electric wave, if present in a space through which waves are being transmitted.*

If it be a fact, as suggested by Professor J. J. Thomson, that the sun is projecting into space streams of electrons, and if these are continually falling in a shower upon the earth, in accordance with the fascinating hypothesis of Professor Arrhenius, then that portion of the earth's atmosphere which is facing the sun will have present in it more electrons or gaseous ions than that portion which is turned towards the dark space, and it may therefore be less transparent to long Hertzian waves.† In other words, clear, sunlit air, though extremely transparent to light waves, may act as if it were a slightly turbid medium for long Hertzian waves. The dividing line between that portion of the earth's atmosphere which is impregnated with gaseous ions or electrons, is not sharply delimited from the part not so illuminated, and there may be therefore a considerable penetration of these ions into the regions which I may call the twilight areas. Accordingly, as the earth rotates, a district in which Hertzian waves are being propagated is brought towards the time of sunrise, into a position in which the atmosphere begins to be ionised, althongh far from as freely as is the case during the hours of bright sunshine.

Mr. Marconi states that he has found a similar effect between inland stations, signals having been received by him during the night, between Poldhu and Poole, with an aerial the height of which was not sufficient to receive them by day. It has been found, however, that the effect simply amounts to this, that rather more power is required by day than by night, to send signals by Hertzian waves over long distances.

Some interesting observations have also been made by Capt. H. B. Jackson, R.N.,‡ on the influence of various states of the atmosphere upon Hertzian wave telegraphy. These experiments were all made between ships of the Royal Navy furnished with Hertzian wave telegraphy apparatus, on the Marconi system. Some of his observations concerned the effect of the interposition of land between two ships. He found that the interposition of land containing iron ores reduced the signalling distances, compared with the maximum distance at open sea, to about 30 per cent. of the latter, whilst hard limestone reduced it to nearly 60 per cent., and soft sandstone or shale to 70 per cent. These results are held by him to show that there is a considerable absorption effect when waves of a certain wave length pass through or over hard rocks containing iron ores. It would be interesting to know, however, whether this reduction was in any degree proportional to the dryness or moisture of the soil. Earth conductivity is far more dependent upon the presence or absence of moisture, than upon the particular nature of the material which composes it other than water.

These observations, however, only confirm the already well-known fact that Hertzian waves, within a certain range of wave length, are to some extent weakened by their passage through land, over land, or round land. In some cases, he noticed that quite sharp electric shadows were produced by rocky promontories projecting into the line of transmission. His attention was also directed (*loc. cit.*) to the more important matter of the effect of atmospheric electrical conditions upon the transmission. The effect of lightning discharges, whether visible or invisible, is to make a record on the telegraph receiver. On the approach of an atmospheric electrical disturbance towards the receiving station on a ship, the first visible indications generally are the recording of dots at intervals from a few minutes to a few seconds on the telegraphic tape. Captain Jackson states that the most frequent record is that of three dots, the first being separated from the other two by a slight interval, like the letters E I on the Morse code, and this is the sign most frequently recorded by distant lightning. But in addition to this, dashes are recorded and irregular signs, which, however, sometimes spell out words in the Morse code. He noted that these disturbances are more frequent in summer and autumn than in winter and spring, and in the neighbourhood of high mountains more than in the open sea. In settled weather, if present, they reach their maximum between 8 and 10 p.m.,

* See "Phil. Mag.," vol. 4, p. 253, Series 6, August, 1902, J. J. Thomson, on some consequences of the emission of negatively electrified corpuscles by hot bodies.

† The opinion that ionisation of the air by sunlight is a cause of obstruction to Hertzian waves propagated over long distances, has also been expressed by Mr. J. E. Taylor. See "Proc. Roy. Soc.," vol. 71, p. 225, 1903, "Characteristics of Earth-current Disturbances and their Origin."

‡ See "Proc. Roy. Soc.," May 15th, 1902, "On Some Phenomena affecting the transmission of Electric Waves over the Surface of the Sea and Earth," by Capt. H. B. Jackson, R.N., F.R.S.

and frequently last during the whole of the night, with a minimum of disturbance between 9 a.m. and 1 p.m. Another matter noted by Captain Jackson is the shorter distance at which signals can usually be received when any electrical disturbances are present in the atmosphere, compared with the distance at which they can be received when none are present. This reduction in signalling distance may vary from 20 to 70 per cent. of that obtainable in fine weather. It does not in any way decrease with the number of lightning flashes, but rather the reverse, the loss in signalling distance generally preceding the first indications on the instrument of the approaching electrical disturbance. Captain Jackson gives an instance of ships, whose normal signalling distance was 65 miles, failing to communicate at 22 miles when in the neighbourhood of a region of electrical disturbance. There is always a difficulty, however, in determining how far such effects are due to external conditions, or to variations in skill in using the instruments. These effects in the case of wireless telegraphy have their parallel in the disturbances caused to telegraphy with wires by earth currents or magnetic storms.

Another effect which he states reduces the usual maximum signalling distance, is the presence of material particles held in suspension by the water spherules in moist atmosphere. The effect has been noticed in the Mediterranean Sea, when the sirocco wind is blowing. This is a moist wind conveying dust and salt particles from the African coast. A considerable reduction in signalling distance is produced by its advent.

Another interesting observation due to Captain Jackson, is the existence of certain zones of weak signals. Thus, for instance, two ships at a certain distance may be communicating well; if their distance increases, the signalling falls off, but is improved again at a still greater distance. He advances an ingenious theory to show that this fact may be due to the interference between two sets of waves sent out by the transmitter, having different wave lengths.

Finally, in the paper referred to, he emphasises the well known fact that long distance signalling can only be accomplished by the aid of an aerial wire and a "good earth." Summing up his results, he concludes (1) that intervening land of any kind reduces the practical signalling distance between two ships or stations, compared with that which would be obtainable over the open sea, and that this loss in distance varies with the height, thickness, contour, and nature of the land. (2) Material particles, such as dust and salt, held in suspension in a moist atmosphere, also reduce the signalling distance, probably by dissipating and absorbing the waves. (3) That electrical disturbances in the atmosphere also act most adversely, in addition to affecting the receiving instrument and making false signals, or *strays* as they are called. (4) That with certain forms of transmitting arrangement, interference effects may take place which have the result of creating certain areas of silence very similar to those which are observed in connection with sound signals from a siren.

It is clear, therefore, from all the above observations, that Hertzian wave telegraphy, taking place through the terrestrial atmosphere, is not by any means equivalent to the propagation of a wave in free or empty space, and that just as the atmosphere varies in its opacity to rays of light, sometimes being clear and sometimes clouded, so it varies from time to time in transparency to Hertzian waves.

We may in conclusion, review a few of the outstanding problems awaiting solution, in connection with Hertzian wave wireless telegraphy. The question of localising the source of the signals and waves is most important. Our kumascopes and receiving appliances at present are like the rudimentary eyes of the lower organisms, which are probably sensitive to mere differences in light and darkness, but which are not able to *see* or *visualise*, in the sense of locating the direction and distance of a radiating or luminous body. Just as we have, in using our eyes, to learn to see, so a similar process has to be accomplished in connection with Hertzian telegraphy, and the accomplishment of this does not seem by any means impossible or even distant. We are dealing with hemispherical waves of electric and magnetic force, which are sent out from a certain radiating centre, and in order to localise that centre we have to determine the position of the plane of the wave, and also the curvature of the surface at the receiving point. Something therefore equivalent to a range finder, in connection with light, is necessary, to enable us to locate the distance and the direction of the radiant point.

Then there are important improvements possible in connection with the generation of the waves themselves. At the present moment

our mode of generating Hertzian waves involves a dissipation of energy in the form of the light and heat of the spark. Just as in the case of ordinary artificial illuminants, such as lamps of various kinds, we have to manufacture a large amount of æther radiation of long wave length, which is of no use to us for visual purposes; in fact, creating ninety-five per cent. of dark and useless waves for every five per cent. of luminous or useful waves, so in connection with present methods of generating Hertzian waves, we are bound to manufacture by the discharge spark a large amount of light and heat rays which are not wanted, in order to create the Hertzian waves we desire. It is impossible yet to state precisely what is the efficiency in the ordinary sense of the word, of a Hertzian wave radiator, viz., how much of the energy imparted to the aerial falls back upon it, and contributes to the production of the spark, and how much is discharged into the æther, in the form of a wave.

Nothing is more remarkable, however, than the small amount of energy which, if properly utilised in electric wave making, will suffice to influence a sensitive receiver at a distance of even one or two hundred miles. Suppose, for instance, that we charge a condenser consisting of a battery of Leyden jars, having a capacity of one seventy-fifth of a microfarad, to a potential of 15,000 volts, the energy stored up in this condenser is then equal to 1·5 joules, or a little more than one foot-pound. If this energy is discharged in the form of a spark 5 millimeters in length, through the primary coil of an oscillation transformer, associated with an aerial 150 feet in height, the circuits being properly tuned by Mr. Marconi's method, then such an aerial will affect, as he has shown, one of Mr. Marconi's receivers, including a nickel silver filings coherer tube, at a distance of over 200 miles over sea. Consider what this means. The energy stored up in the Leyden jars cannot all be radiated as wave-energy by the aerial; probably only half of it is thus radiated. Hence the impartation to the æther at any one locality, of about half a foot-pound of energy in the form of a long Hertzian wave, is sufficient to affect sensitive receivers situated at any point on the circumference of a circle of 200 miles radius described on the open sea. Hertzian wave telegraphy is sometimes described as being extravagant in power, but as a matter of fact the most remarkable thing about it is the small amount of power really involved in conducting it. On the other hand, Hertzian wave manufacture is not altogether a matter of power. It is much more dependent upon the manner in which the æther is struck. Just as half-an-ounce of dynamite, in exploding, may make more noise than a ton of gunpowder, because it hits the air more suddenly, so the formation of an effective wave in the æther is better achieved by the right application of a small energy, than by the wrong mode of application of a much larger amount. If we translate this fact into the language of electronic theory, it amounts simply to this. It is the electron alone which has a grip of the æther. To create an æther wave we have to start or stop crowds of electrons very suddenly. If in motion, their motion implies energy, but it is not only their energy which is concerned in the wave making, but the acceleration, positive or negative, *i.e.*, the quickness with which they are started or stopped. It is possible we may discover in time a way of manufacturing long æther waves without the use of an electric spark, but at present we know only one way of doing it, viz., by the discharge of a condenser, and in the discharge of large condensers of very high potentials, it is difficult to secure that extreme suddenness of starting the discharge which we can do in the case of smaller capacities and voltages.

How strange it is that the discharge of a Leyden jar, studied so profoundly by Franklin, Henry, Faraday, Maxwell, Kelvin, and Lodge, should have become an electric engineering appliance of great importance.

It is not necessary for us to discuss here those questions of policy which are involved in the public and private use of Hertzian wave telegraphy. The legislative restrictions which retarded the progress of some older electric industries in Great Britain, is an ancient and familiar story, and the manner in which any commercial enterprise can be facilitated by wise legislation, or crippled by unwise legislation, is illustrated in the most forcible manner by the recent advances of the motor-car industry. It may be that regulations, perhaps international conventions, may be at some distant day necessary to conserve the use and prevent the abuse of the æther, but it is for the greatest advantage of the greatest number that they should be such as to hinder in the least possible degree this latest and most interesting development of the art of electric telegraphy.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

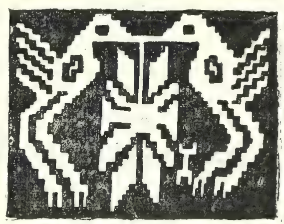
CONVENTIONALISM IN PRIMITIVE DESIGN.

Mr. Carl Lumholtz, in his book on "Unknown Mexico," recently published by Messrs. Charles Scribner and Sons in New York, and by Messrs. Macmillan and Co., Ltd., in London, has given the results of five years' exploration among the tribes of the Sierra Madre and the adjoining districts of Mexico. Among the many valuable observations which Mr. Lumholtz made of these little known and primitive people occur some suggestive remarks about the growth of conventional design among a primitive people, which seem to have considerable bearing on the early history of design, and for that reason to be well worth publication in the Society of Arts *Journal*. By the kindness of the American and English publishers permission was obtained to reprint the passages in question, with the very full series of illustrations which Mr. Lumholtz had secured. It is hoped that by thus reprinting them they may be brought under the notice of many interested in the early history of art, who not being professed anthropologists, might not otherwise have had their attention drawn to the very interesting book of travels, of which these observations form part:—

"There are to-day few, if any, investigators who doubt that the decorations of primitive man are the results of his contemplation of nature and natural objects. No savage ever sat down to decorate an article from mere fancy with meaningless designs. With the Huichols all designs are derived from the animal and plant world, from objects important in the domestic economy and religious life of the tribe, and from natural phenomena familiar to the people. The designs are found almost entirely in the wearing apparel of the people, and may be woven, embroidered, or formed in beadwork. Those which I have illustrated here are all woollen textile work, with the exception of one which is embroidered.

"Girdles and ribbons, inasmuch as they are considered as rain-serpents, are in themselves prayers for rain and for the results of rain, namely, good crops, health, and life; and the designs on these objects are made in imitation of the markings on the backs of the real reptiles, as they appear to the eye of the Indian, and are meant to set forth the desires of the maker or wearer of the band. The double water-gourd, even in its most conventionalised form, means a prayer for water, the source of all life and health. Animals, like the lion, the jaguar, the eagle, &c., express prayers for protection, as well as adoration of the deity to which the creatures belong (see Fig. 2, p. 786).

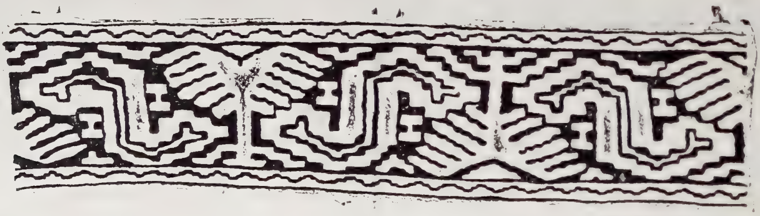
Fig



Textile esign: Humming-birds on a Flower of the Hapani Vine.

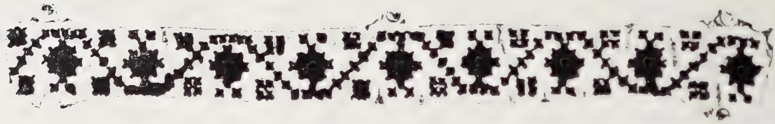
"The assertion has been made that plant or flower designs in aboriginal America are due only to foreign influence, to the early missionaries, who desired to divert the mind of the natives from decorations of deep symbolic and religious significance to the innocent motives of the plant world. This is true only to a certain extent. It applies, for instance, to the Tarasco Indians in Michoacan, who in their beautiful lacquer work generally copy flowers from nature. But the statement certainly does not hold good with the Huichols, because, in the first place, the missionaries have made, comparatively speaking, only small and transient changes in the mental status of the tribe. Secondly, flowers play, and always have played, an important part in the religion of these Indians. With them flowers, like the plumes of birds, are prayers for rain and life. They are sacrificed to the God of Fire and to other deities, being deposited in the niches of the temples, at springs and pools, in caves and other sacred localities.

FIG. 2.



PART OF RIBBON, WITH ALTERNATE DESIGNS OF THE DOUBLE-HEADED SERPENT AND A PALM-TREE Small Water-gourds may be observed.

FIG. 3.



EMBROIDERY REPRESENTING A CREEPER HAPANI, SHOWING FLOWERS AND LEAVES.

No flower is ever plucked unless with some pious intention. At certain feasts the women wear wreaths of flowers on their heads, or place single blossoms behind the ear, while

FIG. 4.

A POUCH BEFORE BEING SEWN TOGETHER. Design: the Flower *Corpus*, and Combs placed lengthwise. Length, 12·5 ctm.

the men fasten flowers to their hats. It is, therefore, but natural that flower-designs should have become as prominent as animal-designs in the decorative art of the Huichols.

"I use this expression, although there is no such thing as ornamentation for decorative purposes, *per se*, with the Huichols, nor, probably, with any primitive people. Neither does the theory of chance suffice to explain primitive designs; nor can an ornament be explained by guessing its meaning according to white man's reasoning, for it should always be remembered that in interpreting primitive symbols and designs it is never the first and most obvious explanation which is true.

"A design may in time become so conventionalised that a white man will fail to recognise the object the artist intended to represent, unless the Indians themselves interpret it for him. Nevertheless, the results obtained are highly pleasing, and thus eloquent of the sense of beauty innate in the race. Even should the original meaning of any one design be forgotten, the belief in its efficacy still survives, and on this account the figure is perpetuated.

"In looking over Huichol patterns we cannot help being struck with the fact that hardly any two are exactly alike. This variety is characteristically Indian. This varies, of course, with the skill and imagination of the artist. It may happen that a woman, always alert to find a pattern more pleasing to her than the one she has, may copy one from a friend. Another deciding circumstance is the size or shape of the article to be decorated. In very narrow ribbons or girdles, for instance, the patterns have to be compressed, and consequently assume changed aspects.

"The articles which the Huichols buy from

the Mexicans, and which are of more or less consequence to the art industries of the tribe, are mainly: coarse cotton cloth (manta), thread and needles, red flannel, beads, printed handkerchiefs, crewel, and steels for striking fire. Along with the foreign material a slight foreign influence has come into the designs, though in the main they have remained intact. Some new forms have been added, such as

FIG. 5.

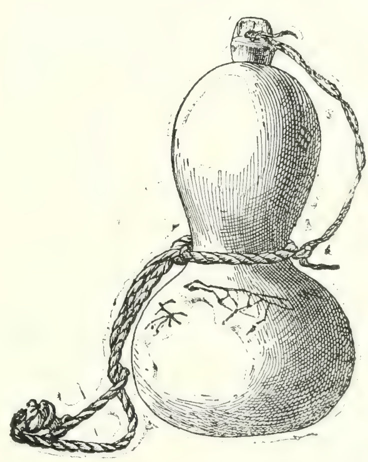
THE END OF A GIRDLE. Main Design: a Double Representation of the Flower Piriki.

that of the steel for striking fire, the jew's-harp, the horse, ox-horns, &c. The shape of the steel, quite handsome in itself, has been developed by the Huichol into interesting conventional designs for his girdles and pouches. In fact, these Indians, who revere the steel on account of its connection with the God of Fire, have worked it into designs even more beautiful than the original. Glass beads with their various colours have facilitated the rendering of symbolic designs, and enhanced

FIG. 6.

THE END OF A GIRDLE. Probably Ancient Flint Tips of the Arrow are shown in the design.

FIG. 7.



THE DOUBLE WATER-GOURD OF THE HIKULI-SEEKER. Height, 22·5 ctm.

their beauty; thus their influence, too, has been rather advantageous to the development of Huichol art.

"The coloured handkerchiefs cannot be considered equally beneficial. Fortunately, the gorgeously painted animals and flowers, although they appeal to the Indian strongly, are mostly too difficult for him to copy. Only the purely ornamental designs are within easy reach of his capabilities. Although he puts into them his own meaning, it can quite readily be seen that foreign influence is finding a way to infect his primitive art. The detriment so far wrought, however, is not great, as the possession of such handkerchiefs is rare, and there is seldom a pattern on them that appeals to him sufficiently to induce him to copy it.

"The loom on which the often really artistic work is executed is of the most primitive construction. One end is tied to a tree or stick, while the weaver fastens the other to her girdle. The "beating stick" is made of Brazil-wood. Woollen shirts, of which at present not half a dozen specimens exist in the tribe, are made in one long strip, which is folded over and sewn up at the sides, short sleeves being put in separately. The loom on such large pieces are woven lies on the ground.

"If a woman were constantly at work on her loom, it would take her about six days to finish a girdle; but as she has many other duties to attend to it often requires three weeks and more to make one. The pattern at the ends of the girdles is always somewhat different from that used in the main part. There are generally some transverse zigzag lines, symbols of lightning, seen here. The portion of the warp left open at both ends is plaited into one braid, sometimes into two, and fastened with a knot.

"Ribbons are mostly like small girdles, and, owing to their narrowness, the designs are generally more delicate and also more finely executed. Pouches are woven in one piece, which is then folded in the middle and sewn up at the sides. Embroidery, sometimes done by men as well as women, is executed in cross-stitch with marvellous accuracy. It is always made on cheap cotton cloth, the thread being obtained by unravelling red flannel. In the possession of the American Museum of Natural History, New York, is a skirt with a beautifully embroidered border, four feet eight inches long and four and a quarter inches wide, in ever-varying patterns.

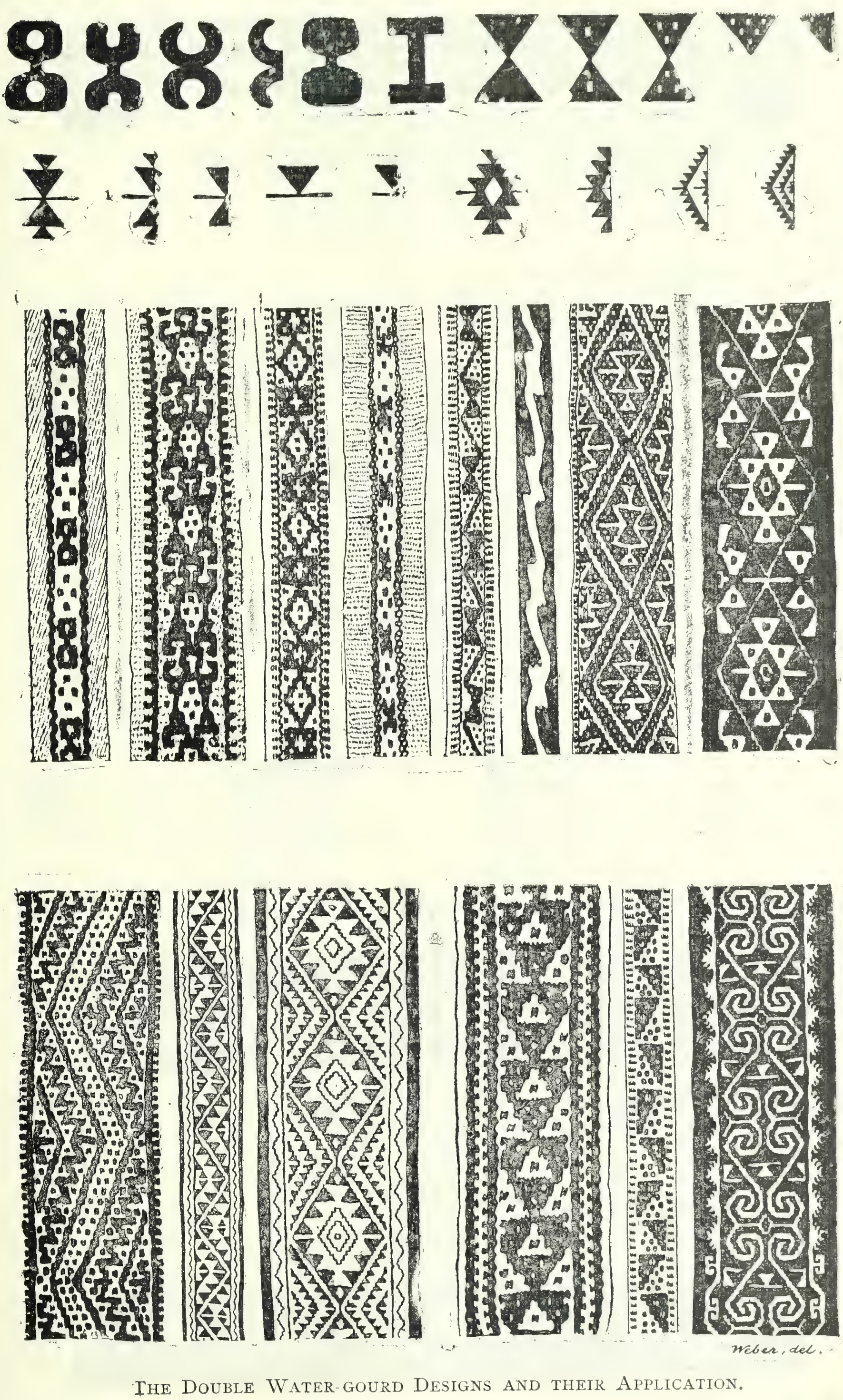
"In my purchases of decorated articles, as well of other symbolic objects, I always made a point also of getting the interpretation of the decoration. Often the men knew nothing definite about the meaning of the designs on the girdles, ribbons, and pouches; and it was difficult to find a woman able to interpret the designs worked by another. As a rule the people are willing to part with their beautiful work, but there are also instances in which no influence, not even that of the gobernador, will induce a woman to sell any of her handiwork.

"The double water-gourd furnishes the motives most often met with. The gourd itself is simply an abnormal growth of the gourd, resembling two gourds connected with a slender neck. It is provided with a stopper, sometimes consisting simply of a corn-cob, and it is carried by a string tied around the middle. Such gourds are used by the hikuli-seekers for bringing water from the home of the holy plant. Such a gourd as the one depicted here is of the size the Huichol carries about with him for everyday use. The double water-gourd is considered magical, and has become the strongest symbol of water. It is also, with the exception of the cross, the most extensively used design in America. It was commonly used amongst the Aztecs as well as among the ancient Peruvians (see Fig. 7, p. 787).

"In the full-page picture (see Fig. 8, p. 789), in the two upper rows, I have given a table of the evolution of the double water-gourd designs, the result of a study of a very large number of Huichol pouches, girdles, ribbons, &c. The first figure to the left in the upper row is a fair representation of a double water-gourd, and the reader will be able to follow the successive stages of the design until it finally becomes simply a triangle: half and at last a quarter of the gourd.

"In the second row, the string around the middle of the gourd has been added in the shape of a transverse line. Here the stopper, too, has been incorporated in the pattern, and for the sake of symmetry it has also been applied to the bottom of the gourd. The second design is simply half of the first cut lengthwise. In the third the stoppers have been left out. The fourth is the upper part of the first with the stopper left out, and the fifth is simply half of the fourth. The sixth is a more symmetrical rendering of the first, two pairs of angular points being added; a god's eye has been made in the middle. The seventh is half of the sixth. In the eighth and ninth

FIG. 8.



THE DOUBLE WATER-GOURD DESIGNS AND THEIR APPLICATION.

FIG. 9.

RIBBON, WITH DOUBLE WATER-GOURD DESIGNS.

FIG. 10.

HUICHOL COMB OF FIRE. Length, 12 ctm.

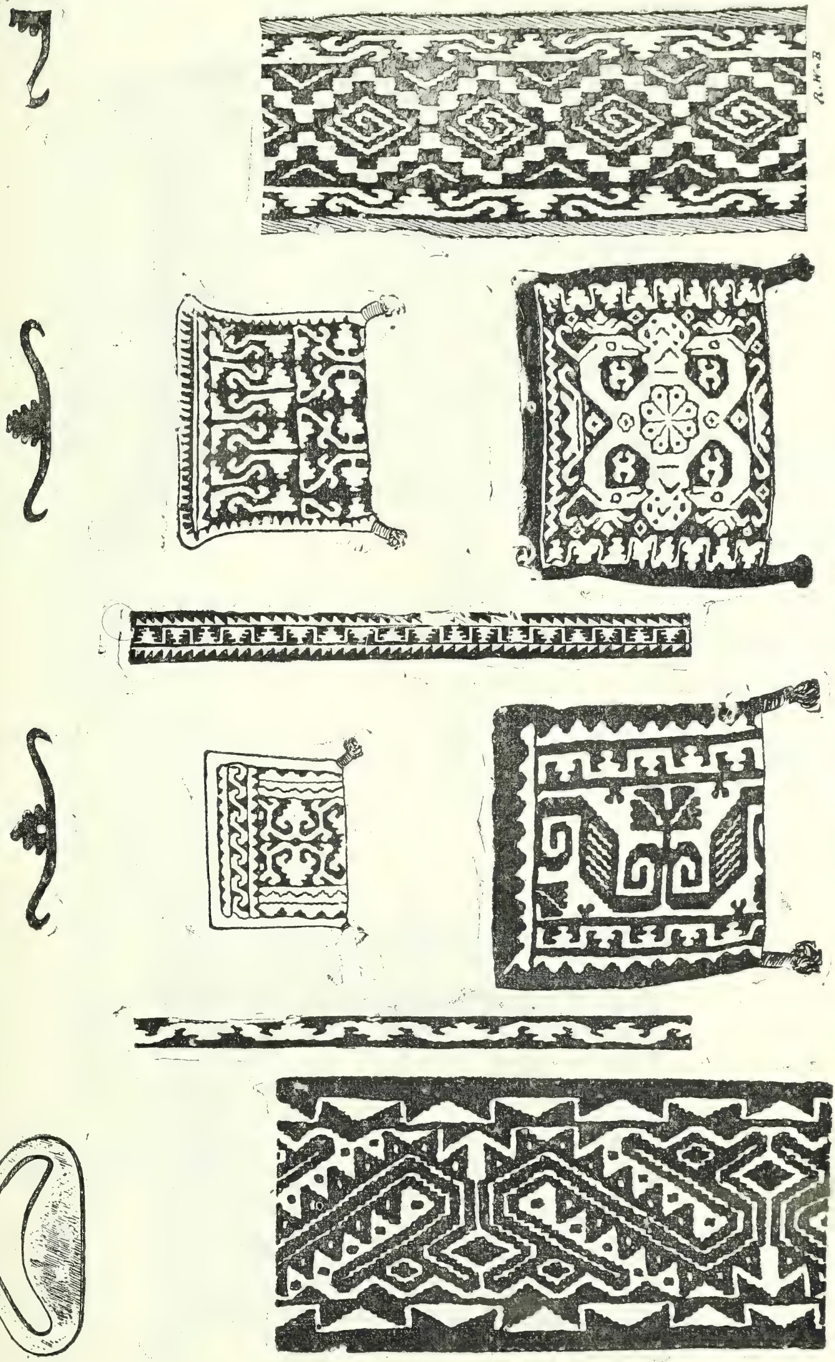
FIG. 11.

PART OF HUICHOL RIBBON, WITH ALTERNATE DESIGNS OF THE COMB AND THE DOUBLE WATER-GOURD.

FIG. 12.

PART OF THE HUICHOL RIBBON, WITH THE DESIGN OF THE STEEL FOR STRIKING FIRE.

Fig. 13.



The Design of the Steel for Striking Fire and its Application. A Reproduction of the Steel itself is seen in the upper left-hand corner.

Fig. 14.

Pouch, with Design of the Royal Eagle. Width, 13 ctm.

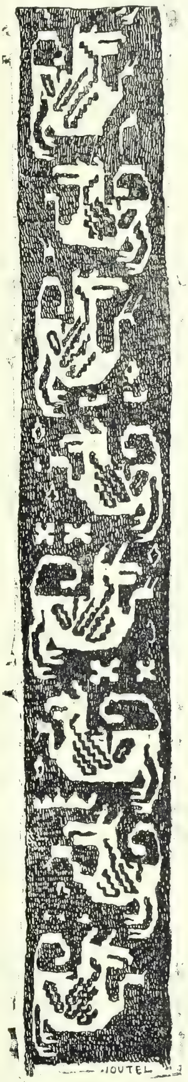
Fig. 15.

Pouch, with Designs of the Royal Eagle. Width, 22 ctm.

he number of points is increased, and even nore rows are added.

"In the lower part of the plate is shown the application of these various double water-gourd designs to girdles; these are easily recognisable.

Fig. 16.



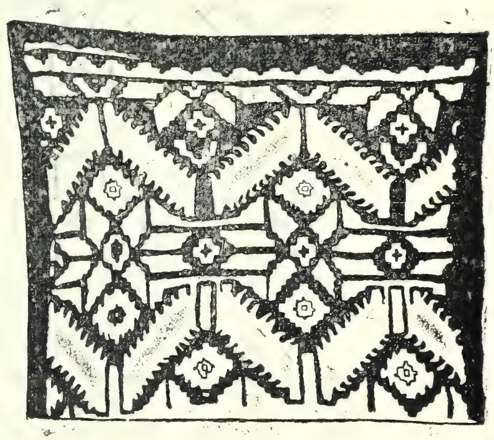
Part of Ribbon, with Design of Dogs.

"In the ribbon (Fig. 9) the double water-gourd design is very distinct. It should also be noted that the crossing zigzag lines form a god's eye, like a frame for each design. Placing the girdle in a perpendicular position, one will also readily perceive how a second double water-gourd, more conventionalised, has been reproduced on the outside of the frame, enclosing the first one.

"The Huichol comb also furnishes a motive for designs, though not very common. It looks like a small whisk-broom and is made from fibre of the century-plant, *lechuguilla*, which is brought from the hikuli country. The twine around the handle has been tied so as to form a butterfly design. The unevenness on the top of the comb, the natural result of the tying of the fibres, has in the design been utilised at both ends (see Figs. 10 and 11, p. 790).

"The steel for striking fire, though of comparatively recent introduction, is closely associated with the religious conceptions of the tribe, because the fire is their greatest god,

Fig. 17.



Pouch, with Designs showing Insect Borings on Trees; also the Flower Toto. Width, about 11 ctm.

and the steel represents him. Since all sacred things are symbols to primitive man, the Huichols have adopted the implement among their decorative designs. In Fig. 13 (p. 791) is seen the steel as sold by the Mexicans and the three designs evolved from it.

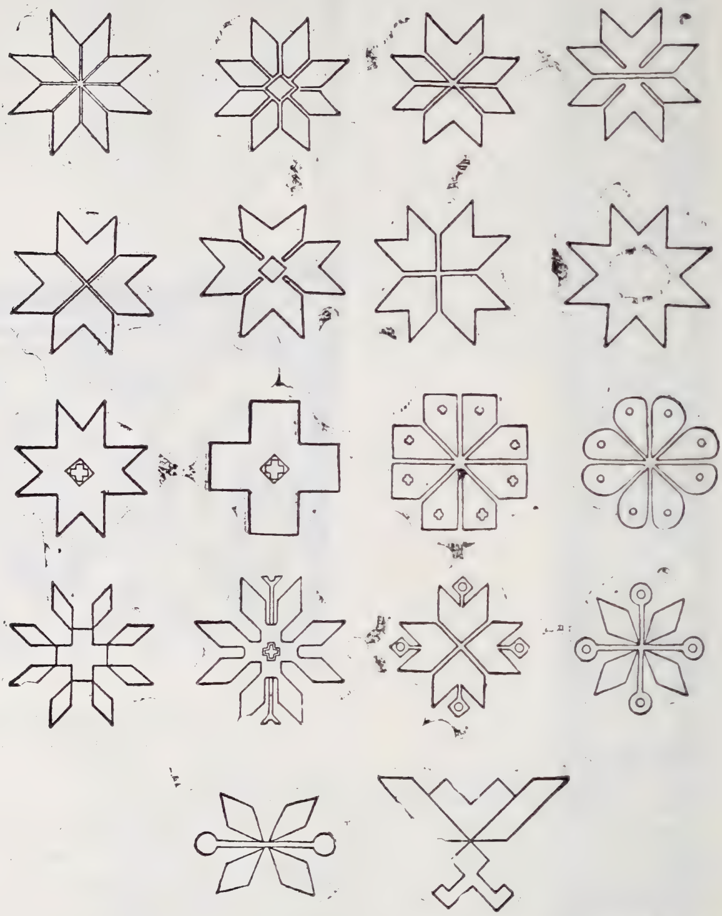
"This design is generally applied in rows, being especially utilised as borders to girdles and pouches as seen in its application on the next page. In the two small pouches seen on the upper portion of Fig. 13 are found other combinations of the steel design; in the one to the left two entire designs being represented, in the one to the right halves and quarters. Other designs here are: on the girdle to the left the double-headed serpent, and on the pouch following, two leaves and a flower of the banana placed lengthwise; on the girdle to the

right, which is a beautiful imitation of a serpent's back, a series of god's eyes.

"The notched lines and the zigzag lines seen as borders of pouches and ribbons, both here and in other cases, signify generally, the first one, notched deer-bones; the second, either lightning or squash-vines.

the first pouch may be observed crowns which are due to contact with civilisation. The guardian young mother-eagle above is to the Huichol synonymous with the Virgin Mary, whose image they have seen provided with a crown, which here is reproduced. Of more interest, because showing no contamination

Fig. 18.



Evolution of the Toto Design, based on explanations supplied by the Natives. All ar Interwoven or Embroidered except the Last, which is Bead-work, and represents the Flower in Side View.

"The royal eagle is a favourite design on pouches (see Figs. 14 and 15, p. 792). The young female eagle, which is believed to hold the world in its talons, guards specially the corn; hence the flower toto, the symbol of corn, is pictured on the breasts of these eagle designs. As before explained, the designs have absolutely no connection with the double-eagle heraldic devices of Europe, but about the heads of the design on

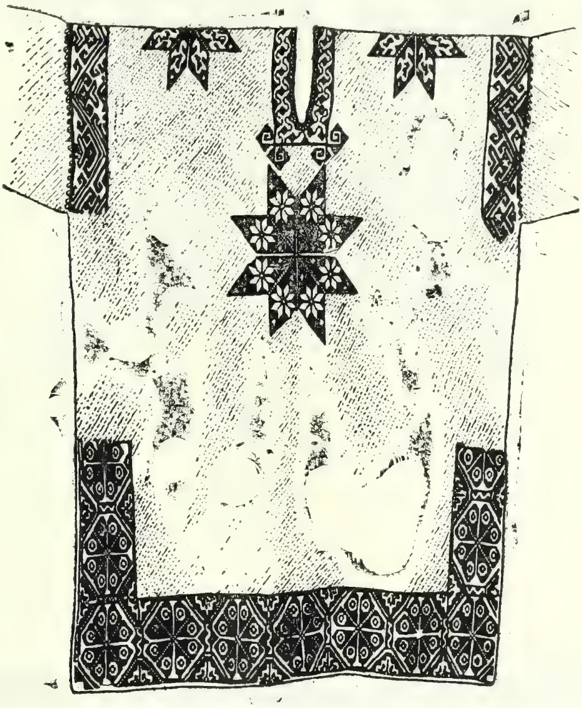
with the white man's ideas, is the beautiful and effective design of eagles in the second pouch. The plumes on the heads are executed in daring and impressive curves, and the combination of the two eagles into one is highly artistic and may be favourably compared with the best heraldic designs of mediæval times. The right and left border is composed of the toto flower, parts of which are also seen to fill out the space between the heads in a tasteful

ıanner. The main design in the upper order is one very often seen. It is, in the Iuichol conception, a conventionalised ren-ering of the linking of hands as seen from he side.

"The pouch with the two large zigzags ıas an interesting design, the zigzags repre-senting the borings which a certain insect nakes under the bark of trees. The borings ıre also called the "facial paintings of the ree." The rest of the designs is almost entirely the toto flower (see Fig. 17, p. 793).

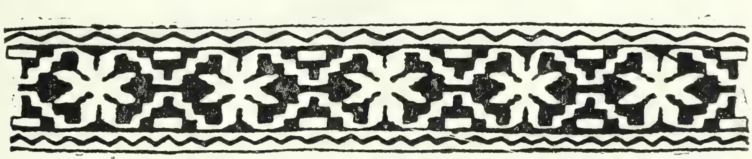
"In the Huichol country the little white flower called toto grows during the wet, corn-pro-ducing season, and therefore becomes a prayer as well as a symbol for corn. The women especially, are often seen with the corolla of this flower stuck with saliva to each cheek, thereby expressing their wishes to the gods. To have the flowers permanently with them, the Huichols weave them into their girdles, and embroider them on their garments. As the thought conveyed by this flower is ever uppermost in the mind of the people, the design appears very frequently. I have gathered all the various forms in which this design is utilised (Fig. 18). A slight similarity to Oriental designs may suggest some foreign influence; on the other hand, flower designs are by their nature subject to limitations, so that a certain likeness between the pro-ductions of distant tribes and races must

Fig. 19.



Man's Woollen Shirt, with Embroidered Designs of the Flower Toto.

Fig. 20.



Part of Ribbon, with Designs of the Flower Toto and of Butterflies (the rows above and below of triangular figures).

FIG. 21.

POUCH, WITH DESIGNS OF THE FLOWER TOTO. Width, 15·5 ctm.

FIG. 22.

POUCH HAVING AS MAIN DESIGN THE FLOWER TOTO. Width, 38 ctm.

lways be expected. A curious discrepncy is here observable. The real flower as five petals, but conventionally it is repreented with four or eight, or sometimes six. 'his may be due either to the desire to nake the flower conform to the four corners r the six regions of the world, or to lack f skill in making an evenly five-pointed tar.

"Various forms of this design may be seen on he shirt, which is woven from white wool and mbroidered in red (Fig. 19). The conspicuous oto design in front has eight small totos within t. Within the petals on the shoulders macaos ire represented (see Figs. 18, 19, 20, and 21).

"In the beautiful pouch (see Fig. 22,). 796) which has mainly designs of this lower, it may be noticed that each flower s placed within another more conventionalsed representation of it (a cross). Even he little rectangular additions above and below are probably extremely conventionalised forms of this design. The oblique lines crossing each other on the entire side of the pouch produce god's eyes, one for each flower. The several transverse rows of zigzag lines symbolise squash-vines, the middle row having also the squashes expressed by dots.

"I have been able to reproduce here but a small portion of Huichol designs, but enough, I hope, to show that barbaric people have more innate artistic sense than they are credited with.

"Why is it people of what we call inferior races, or even savages, are artistic in the productions which they make for their daily use, while civilised man requires to be stimulated to an appreciation of art? Compare the markings of even an Australian cannibal, the lowest savage on earth, on his shield or his basketry work, with any ornamental attempts of the common white labourer. The result is not flattering to the white race. I have often pondered this. Sometimes I have thought it was because we lived too far from nature. Is there perhaps something wrong in our boasted civilisation?

"I do not mean to say that the backward races have any appreciation whatsoever of our art; but the astounding fact is that they unconsciously turn out such beautiful conventionalised designs, as for instance may be seen among the Huichols, while in civilisation we have to establish societies to encourage people to surround themselves with objects of beauty. *L'art domine la nature* seems to be true in more than one sense."

Miscellaneous.

THE MYSTERY OF RADIUM.

Last March the *Times* announced the discovery by M. Curie of the astonishing fact that radium, in addition to the radio-active properties rendered more or less familiar by the researches of M. Becquerel on uranium, possesses the property of maintaining its temperature at a point three degrees higher than that of its surroundings, and of continuously emitting heat without any apparent diminution of bulk or alteration of physical constitution. This announcement was received with great incredulity. Eminent men of science refused to accept a statement so irreconcilable with scientific experience, and maintained that there must have been somewhere a serious error of observation. That radium possessed radio-active properties indefinitely more powerful than those displayed by any other body was a fact of an order to which we were accustomed. These properties, however remarkable, differed only in degree from properties with which the scientific world was familiar. That difference in degree has indeed become sufficiently astonishing in the light of further study, for it has become clear that radium without external stimulus can produce effects hitherto only obtainable by means of electric discharge in high vacua. It can throw gases into that state of vibration which causes the production of their characteristic spectrum, and it emits at the same time a radiation resembling the Röntgen rays, and producing like them marked physical and physiological effects. Superadded to this extraordinary development of powers not unfamiliar in their lower manifestations, is the unique and unprecedented power of emission of heat, which is now established beyond all possibility of question. That gross physical effect, in addition to the radioactive and physiological effects produced on so large a scale, points to an amazing total output of energy for which no compensation has yet been discovered.

Strenuous efforts have of course been made to obtain accurate measurements of the heat production, and to determine the effect of external conditions in promoting or retarding it, M. Curie has just communicated to the French Physical Society a paper stating the results of a recent inquiry. It appears that at the time of his lecture at the Royal Institution in June, the resources of that laboratory in producing and manipulating liquid gases were utilised in a new series of experiments. Professor Dewar had already in 1893 improved the calorimetric use of liquid gases by means of a combination of vacuum vessels so that heat-evolution at the temperature of boiling liquid air or hydrogen could be determined with accuracy. When a sample of radium bromide weighing 0·7 gramme was tested in this way it was found to be capable of volatilising an amount of liquid oxygen and hydrogen equivalent respectively to 6 c.c. and 73 c.c. of the gases measured at the ordinary temperature. It seems that through a very wide

range of temperature the thermal emission remains unchanged. Whether at the temperature of a summer day or at that of liquid air, the emission of heat goes on without perceptible variation. When, however, we make a long, downward stride from liquid air to liquid hydrogen, radium shows that it is not always unaffected by external temperature. Within a comparatively short distance of the absolute zero a change occurs in the rate of heat-emission, but not in the direction that might be anticipated in view of the effect of low temperatures on ordinary chemical action. Instead of being reduced, the emission of heat so far as present data can be relied on, is augmented at the temperature of liquid hydrogen. Whatever be the nature of this extraordinary phenomenon, it only increases in intensity at a point where all but the most powerful chemical affinities are in abeyance. The evaporation of a liquid gas gives an absolute measurement of the amount of heat given off by radium. Changes in the degree of radio-activity may escape the most careful observer, or may be imagined where they do not exist, but the quantity of liquid hydrogen which a given mass of radium converts into gas in a given time can be easily measured with an accuracy which is beyond cavil, and the amount of heat required for the conversion can be ascertained with great precision. Hence there is no longer any doubt either of the quantity of heat evolved by radium or of the fact that the rate of emission is apparently greater in liquid hydrogen than at any temperature from that of liquid air up to that of an ordinary room.

At the beginning of these experiments in liquid hydrogen a contrary result appeared to emerge when the low-temperature thermal measurements were compared with the early Curie values observed at the temperature of melting ice, as formerly given in *The Times*. This led to the curious discovery that a freshly prepared salt of radium has a comparatively feeble power of giving off heat at all temperatures, but that its power steadily increases with age until about a month from its preparation, when it reaches the maximum activity, which it afterwards maintains apparently indefinitely. A solution of a radium salt behaves in exactly the same way. Its power of heat-emission is at first relatively low, but goes on increasing for about a month, when it becomes equal to that of the solid salt, and so remains. These remarkable results throw no light upon the process by which radium maintains its constant emission of heat and radio-activity, but they will have to be accounted for by any theory that may be constructed.—*The Times.*

A letter from Sir Oliver Lodge, F.R.S., was printed in *The Times* of the 17th inst., in which he writes:—

"Referring to the article in your issue of the 13th inst., it may be pointed out once more that all the known properties of radium are consistent with the hypothesis that a rearrangement of parts is going on inside the atom, and that it is not a case of chemical action in the ordinary sense at all. There is no difficulty in accounting for the energy in this way."

CAPER CULTIVATION IN FRANCE.

The caper tree is a bush which is grown in some parts of Spain and Algeria as well as in France. The commercial caper is the flower bud, which is gathered before its development, and preserved in vinegar. The tree thrives on chalky soils, on rising ground, well exposed to the sun. The bushes are propagated by the use of cuttings, which are planted in a place selected as most favourable to their development. Experience proves that it is wiser to plant the cuttings in a soil neither richer nor poorer than the soil into which they are to be permanently transplanted. By the adoption of this rule not more than 20 per cent. of the cuttings survive, but good results are obtained from the successful one-fifth. The ground is well fertilised and ploughed before planting in the spring time, and the bushes are placed at a distance of about 8 feet. They yield a small crop the first year, and in two or three years give a full average crop. Upon the approach of winter every branch is cut down to a length of from 8 to 10 inches, and earth is hoed in a heap over the entire bush, in order to preserve it as much as possible from the frost. This method of precaution is, according to Consul-General Skinner, of Marseilles, carefully attended to in the Department of the Bouches-du-Rhône, where capers are cultivated on a considerable scale. In March the earth is removed and the branches again cut closely to the trunk, which is left bare; the branches themselves are used as cuttings, and the ground is ploughed and manured. The gathering of the crops generally commences the first week in June, and as the branches continue to grow, and as there is one caper for every leaf, the harvest season continues until September, or even October. About the end of July the crop is heaviest. The buds are picked by women, who work upon the same bush every five or six days. An effort is made to gather small capers, as the small sizes are the best and bring the best prices. The pickers are paid at the rate of about one penny a pound, and during the height of the season a competent woman can gather about forty-five pounds a day. After the capers have been picked, they are placed in trays under a shed, where they are left until they evaporate a certain amount of water which they contain in order that fermentation may not set in. They are then placed in barrels of vinegar for preservation. A white vinegar is used for this purpose. Occasionally the brine is flavoured with sprigs of tarragon, elder flowers, cloves, and pepper. The capers having been thus preserved are next classified during the winter by being passed through sieves of different sizes. There are seven classifications as follows:—"Nonpareil" (smallest size), "surfine," "capucine," "capote," "fine," "mifine," "commune" (largest size). Having been thus separated, the capers are replaced in barrels, filled with vinegar, and preserved until sold. When preserved for shipment the capers are washed in vinegar, which renders them quite firm, and they are them placed in barrels, without vinegar, and are enabled to support long voyages.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

THE SOCIETY OF ARTS' EXAMINATIONS.

[In the year 1897 the International Congress of Technical Education held its meeting in London, at the Society of Arts' House. At this meeting a paper on the history of the Society's Examinations was read by the Secretary, Sir Henry Trueman Wood. The information contained in this paper has often been found useful, and as the number of the *Journal* containing it is now nearly out of print it has been thought well to republish it, with such alterations and additions as were required to bring it up to date.]

The Society's Examinations are conducted simultaneously at a number of different centres throughout the kingdom, through the agency of local examination committees established for the purpose by the Society. The papers in each subject are sent down in separate envelopes to the secretary of the committee immediately before the day of examination. The envelopes are opened in the presence of the candidates, and the papers distributed. The worked papers are sealed up at once and despatched to the office of the Society.

The examination system of the Society of Arts was an outcome of the Great Exhibition of 1851, which, as is well known, was originated by the Society. In November, 1851, Mr. Harry Chester, then a Vice-President of the Society and afterwards Chairman of the Council, submitted to the Council a scheme for the formation of a union of mechanics' institutions, the principal object of which was to encourage the founding of such institutions, and to develop the educational facilities which they provided.

Among the early suggestions for the utilisation and development of such institutions was a proposal for a general system of examinations among their members. In December, 1853, Mr. Chester definitely proposed the establishment of such a system, and in the spring of 1854 a scheme of examinations was published. The scheme was of a very comprehensive character, and included the following subjects:—1. Mathematical Sciences; 2. Experimental Sciences; 3. Sciences of Observation; 4. Mechanical Sciences; 5. Social Sciences; 6. Fine Arts; 7. Moral and Metaphysical Sciences; 8. Literature. This very elaborate programme proved a little impracticable, and it is not to be wondered at that only a single candidate offered himself for examination in March, 1854. The promotors of the movement were not, however, discouraged, the scheme was remodelled, principally by Dr. Booth, at that time an active member of the Society, and in 1856 an examination of 52 candidates was held at the Society's house. The subjects of this first examination were:—1. Book-keeping; 2. Arithmetic; 3. Algebra; 4. Mensuration; 5. Geometry; 6. Mechanics; 7. Chemistry; 8. Animal Physiology; 9. Botany; 10. Agriculture; 11. Geography; 12. Physical Geography; 13. English History; 14. English Literature; 15. Latin and Roman History; 16. French; 17. German; 18. Freehand Drawing.

In the following year, 1857, the first attempt at provincial examinations was made, and an examination was held at Huddersfield, as well as in London, the examiners of the Society going down for the purpose. The desire of increasing the number of examination centres, and the obvious impossibility of sending examiners simultaneously all over the country, led in 1858 to the elaboration of the system of local committees to supervise examinations worked from a single centre.

The Society of Arts, however, cannot claim the sole credit of the invention of the system of local examinations. In 1850 the College of Preceptors (established in 1846) was considering the best means of examining the schools of its members. It commenced by sending down examiners, its first school examination having been held in December, 1850, at Nottingham, but in 1853 the experiment was tried of collecting pupils to a centre and examining them by means of papers sent down from London. The experiment proving successful, the system was regularly organised in the following year, 1854, and has been continued ever since.

It will be seen that the College of Preceptors' Examinations preceded those of the Society of Arts by two years, but the objects, the conditions, and the methods of the two systems have been so different that there has never

been any but the most friendly rivalry between them. In 1856 a conference was held at the Society's house between representatives of the two bodies, the College being rather afraid that the Society's Examinations would interfere with their own. It was soon apparent that the two systems were intended to occupy different ground, and were not likely to affect one another. In practice this has proved to be the result, and it has never been found that they have interfered in the least with one another.

To the Society's Examinations in 1858, 58 institutions sent up 288 candidates; in the following year there were 480; in 1860, 586. The numbers increased steadily till 1865, when there were 1,899; the next year showed a slight diminution, and then there was a further increase, till the number of 2,160 was reached in 1869.

The University Local Examinations were established in 1858. The establishment of Elementary Drawing Examinations by the Department of Science and Art was about contemporaneous with that of the Society's Examinations. The Science Examinations began later, in 1861, and as these developed, it was found that the Society's Examinations were in many respects competing with those of the Department. The same candidates were being examined in the same subjects, and there was an evident waste of power. In 1870 this led to the abandonment of 17 out of the 36 subjects then included.

In 1871, when the Council was considering the establishment of a system of Technological Examinations, of which an account is given below, they passed a resolution to discontinue the General Examinations, but on the application of some of the more important of the Institutions in Union, they rescinded the resolution and determined to continue the examinations for a further period. This was done, on the same system as before, till 1876, when the programme was revised, and the plan on which certificates were granted was somewhat modified. Previously, certificates had been granted for single subjects, but in that year a "Commercial Certificate" was established in addition, to take which it was necessary to pass in, at least, three subjects. Very few of these certificates were ever taken, the system of single certificates for single subjects being more popular and better suited to the needs of the class of students who take up the Society's Examinations.

In 1879, the question of abandoning the examinations again arose, it being thought that the ground was covered by other agencies. To quote from the report of the Examination Committee in 1879:—

"The Committee feel that the time has now come when the Society should cease to compete with other educational agencies more influential in the work of examination. With the Education Department examining millions of children in elementary schools, and thousands of young persons in night classes; with the Universities holding their local examinations throughout the country, for young persons of a higher class; with the Science and Art Department examining students in every branch of science and art; with the new City Institute developing yet further the Technological Examinations just handed over to them by the Society; with other agencies, such as the College of Preceptors, doing kindred work, the Society of Arts may well retire from the field, having in all these various directions acted as the pioneer. It held science examinations before the Science Department, examinations in literature before the Universities went afield to meet the classes who could not go to Oxford or to Cambridge. It has seen the system it established develop, with the aid of Government funds, as it could never have grown without such help, and the time has now arrived when it may cease to compete with the agencies it has done so much to foster."

In pursuance of the course mentioned in this report, no examination was held in 1881, but again, however, some of the institutions where the examinations were held protested, and on further consideration it was determined to continue the examinations, but to try whether they could not be made self-supporting. Hitherto they had been free. In 1882 a fee of 2s. 6d. was charged to each candidate, and this charge has been continued to the present date. The "Commercial Certificate" was abandoned and the old system was resumed of giving a separate certificate for each subject. The natural result of fees being charged was a considerable falling off in the numbers examined. In 1882 only 695 papers were worked as compared with 2,325 in 1880. The numbers, however, soon began to increase again. In 1890 there were 2,474; in 1895, 5,108; in 1900, 9,808; and in the present year (in the General Examinations—Grade II.—alone), 11,670. This very considerable increase was doubtless, to a very great extent, due to the facts that the County Councils had been placed in possession of large funds available for the promotion of technical education; and that certain commercial subjects were scheduled by the Science and Art Department as subjects coming within the scope of the Technical

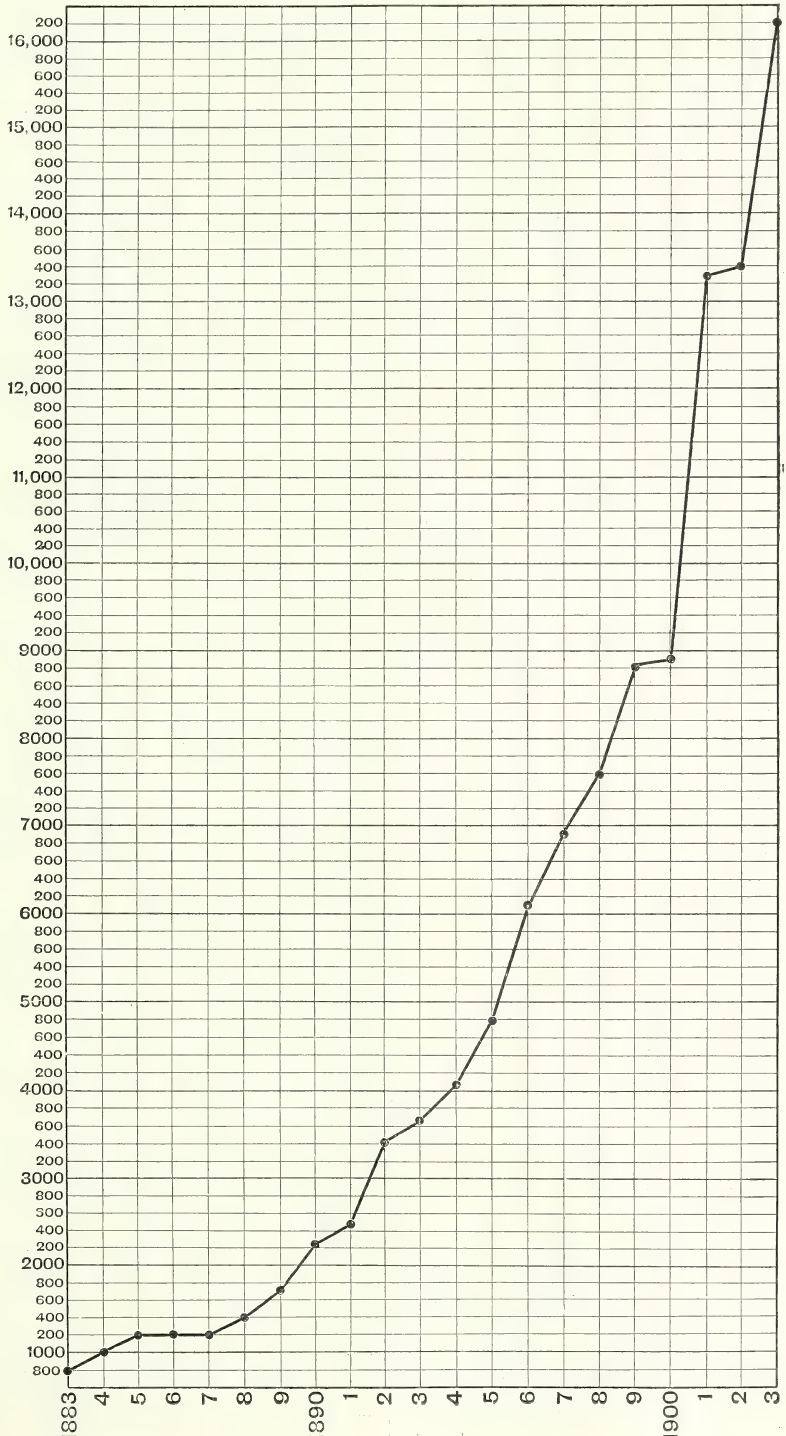

Diagram showing Number of Candidates Examined from 1883 to 1903.

Instruction Act, 1889. The commercial subjects so scheduled are precisely those in which the Society of Arts has now for so long been holding examinations. The total of the numbers examined during the past three years is also increased by the addition of the Elementary Grade.

The growth of the examinations is shown by the diagram on p. 801, which shows the total number of candidates examined (including Grade I., since 1901), and as regards the General Examinations in somewhat greater detail by the following Table. It may be mentioned that the total number of candidates examined by the Society of Arts this year, 1903, in all subjects, including music and *vivâ voce* modern languages, was 17,128.

General Examinations, Grade II.

Year.	No. of Candidates.	No. of Papers worked.	No. of Centres.	No of Subjects.
1883........	808	845	35	10
1884........	991	1,058	38	8
1885........	1,208	1,321	44	11
1886........	1,184	1,274	50	9
1887........	1,232	1,315	46	10
1888........	1,433	1,531	53	11
1889........	1,738	1,861	71	15
1890........	2,315	2,474	79	14
1891........	2,460	2,667	78	14
1892........	*2,928	3,143	96	13
1893........	3,702	3,916	109	13
1894........	4,106	4,376	131	14
1895........	4,777	5,108	146	14
1896........	6,111	6,568	197	16
1897........	6,919	7,513	221	19
1898........	7,636	8,372	243	19
1899........	8,750	9,581	260	23
1900........	8,894	9,808	267	23
1901........	8,797	9,669	276	19
1902........	9,020	9,968	289	19
1903........	10,616	11,670	322	19

The subjects for the General Examinations (Grade II.) now are:—(1.) Arithmetic, (2.) English, (3.) Book-keeping, (4), Commercial Geography, (5.) Shorthand, (6.) Typewriting, (7.) Economics, (8.) Précis-writing, (9.) French, (10.) German, (11.) Italian, (12.) Spanish, (13.) Portuguese, (14.) Russian, (15.) Danish, (16.) Chinese, (17.) Japanese. Separate certificates (First, Second, and Third Class) are given in each subject, and a certificate of proficiency in Commercial Knowledge is offered to any candidate who may pass in five specific subjects during a period of three years. It does not, however, appear that there is much demand for a certificate of this character, as no application has been made for one since the offer was first published in 1901.

* In this year a supplementary autumn examination was held, which brought the total up to 3,351.

In addition to its Commercial Knowledge examinations, the Society conducted, from 1856 to 1894, Elementary Examinations. These were really carried on by District Unions and Local Boards in connection with the Society. All the Society did was to supply identical examination papers, the results being examined and certificates awarded by examiners appointed by the Local Boards. The Society supplied the certificates, but accepted no responsibility as to their award. The system, though useful at its first establishment, was never found to work in a very satisfactory manner, and in 1895 it was abandoned.

There was, however, always a demand for examinations of a more elementary character than the general examinations, and in consequence elementary examinations in modern languages (French, German, and Spanish) were established in 1897. These were fully appreciated, and eventually in 1901 an Elementary or Preliminary grade was added. The subjects selected for this grade included Shorthand, Book-keeping, Arithmetic, Typewriting, Office Work, Commercial Geography, French, and German. In the first year in which it was held, there were 4,458 papers worked in the different subjects, of which 2,494 passed and 1,964 failed. In the following year there was a slight increase, and in the present year the total rose to 6,020, of which 3,676 passed and 2,344 failed. The percentage of successes this year is a little lower than that in the previous year, a result which may probably be attributed to an effort slightly to raise the standard of the examination.

These results may conveniently be shown in the form of a Table, similar to that above.

Elementary Examinations, Grade I.

Year.	No. of candidates.	No. of papers worked.	No. of subjects.
1901	3902	4458	8
1902	4371	4807	8
1903	5382	6020	8

A question which had been for a long time before the Council was the holding of *vivâ voce* examinations in Modern Languages, and as far back as 1870 suggestions, made by the late Mr. Hyde Clarke, for holding such examinations locally, were included in the programme. Nothing, however, came of these suggestions. It is quite obvious that no paper examination can be an adequate test of knowledge of a spoken language; but the difficulties connected with the holding of colloquial examinations simultaneously at a number of different centres for a long time proved insuperable. In 1902 the idea of holding such examinations at the same time as the other examinations was abandoned, and it was announced that examinations in French, German, and Spanish would be held at any date at any of the Society's examination centres where proper arrangements could be made. The experiment proved very successful. In the first year 280 candidates were examined, of whom 202 passed and 78 failed. In the present year 456 candidates have been examined, of whom 324 passed and 132 failed. Portuguese was also added to the list of subjects. It is found on the whole that nearly all the candidates who entered have a very fair colloquial knowledge of the language, while certificates have been granted to a great many who have shown thorough proficiency. No difficulty has been experienced in conducting the examinations satisfactorily, thanks to the energy and ability of the gentlemen whose services as examiners the Society has been successful in securing.

The Technological Examinations, referred to above, were instituted in 1873, at the suggestion of the late Sir John Donnelly. These examinations were intended to test the knowledge possessed by artisans of the subject matter of their respective industries. It was arranged that they should be held in connection with the May examinations of the Science and Art Department, the technological papers being given out with those of the Department. Before a candidate could obtain a certificate, he was required to pass a Department examination in certain specified science subjects, these varying according to the technological subject taken up. Certificates of three grades were given, elementary, advanced, and honours, corresponding with those of the Department examination. No attempt was made to test practical skill, but each candidate was required to produce a certificate from his employer in which his competence was stated. The number of candidates was never great. In the first year (1873) only six entered and the numbers gradually increased to 68 in 1870, and 184 in 1878.*

In 1879, on the foundation of the City Guilds' Technical Institute, the Technological Examinations were handed over to that body. From the funds placed at its disposal by the City companies the Institute was able to offer to teachers payments on the results of the examination in the same manner as the Science and Art Department. Teachers were thus enabled to form classes and send pupils for the examination, and a large increase in the number of candidates took place. These examinations now form an important part of the Institute's work, and attract annually a very large number of candidates. In 1902 the number examined was 15,615. Large additions have also been made to the list of subjects, which now number 66. No great change has been made in the general character or system, which remains much the same as that proposed by Sir John Donnelly, but the details have been considerably modified, and in some cases a practical examination, to test handicraft skill, has been provided.

In 1889 an attempt was made to establish a system of examinations in "Practical Commercial Knowledge." Syllabuses for two subjects, "The Commerce of Food," and "The Commerce of Clothing," were issued, but no candidates came forward, and after a second year's trial, the proposition was dropped.

In 1879, at the suggestion of Dr. Hullah, examinations in Practical Music were established, that is to say examinations at which the actual capacity of students to play an instrument, or to sing, could be tested. It was intended that these examinations should apply to a less advanced class of candidate than those who entered for the well-known examinations of the Royal Academy, at the time the Society's system was started, or who now enter for those of the Associated Board of the Academy and the Royal College of Music. It is believed that the Society's examinations have fulfilled their purpose, and have proved a useful means of encouragement to many musical students. Dr. Hullah acted as examiner from 1879 till his death

* The following were the subjects included in the 1878 examinations:—Cotton manufacture, Paper, Silk, Steel, Carriage-building, Manufacture of Pottery and Porcelain, Gas manufacture, Glass, Cloth, Silk-dyeing, Wool-dyeing, Calico-bleaching, dyeing, and printing, Alkali manufacture, Blow-pipe analysis.

in 1884, and was succeeded by Mr. W. A. Barrett, who died in 1891. The work was continued by Sir John Stainer, Sir Joseph Barnby, and Mr. W. G. McNaught. In 1895 Mr. John Farmer was appointed, and he continued to act till 1899, when he was obliged to give up the work in consequence of illness, which, at a later date, terminated fatally. The examinations are now conducted by Dr. Ernest Walker and Mr. Burnham W. Horner, who served as Assistant Examiners to Mr. Farmer. In the first year of these examinations 117 candidates were examined. The number increased gradually to 276 in 1891 and 395 in 1895. The largest number examined was 566 in 1900. Last year 397 were examined, and 486 in the present year.

Miscellaneous.

BARBADOS COTTON FACTORY.

On Friday, July 31st, the Central Cotton Factory of Barbados, recently erected on the Pierhead, was opened by Lady Morris. The factory, which occupies a site a little above the old Harbour Police Station, is a wooden building, 100 feet in length and 20 feet in width. The machinery consists of one Platt's Double Action Gin, and a Baling Press. Places for two more ginning machines have been marked off. The power is supplied by a ten horse-power engine, in the boiler of which native petroleum is burnt.

Mr. F. J. Clarke, chairman of the Cotton and Onion Cultivation Committee, appointed by the Agricultural Society to act in co-operation with the Imperial Department of Agriculture, gave an account of the scheme for the re-introduction of the cotton industry in Barbados. About two years ago, owing to various reasons, the price of cotton commenced to rise in the English market, and it occurred to Sir Daniel Morris that it would be a wise thing for the West Indies to take up cotton growing, and he accordingly advocated steps being taken to establish the industry. Last year there was a further rise in cotton prices, dne chiefly to anticipation of a smaller crop in the United States, and the British Cotton Growing Association started a vigorous agitation to promote the growth of cotton in English possessions. Several gentlemen here, notably Messrs. Thorne and Cameron, had acted on Sir Daniel Morris's advice to grow cotton as a subsidiary crop to sugar cane, and the results of their experiments had been very satisfactory, and greater attention was therefore directed to the subject. Sir Daniel Morris had in the meantime put himself in communication with the British Cotton Growing Association, and had succeeded in obtaining a grant of money and a gin. He then approached the Agricultural Society, suggesting the appointment of a Committee to see after the erection of the gin and other machinery. This the Society promptly did, and the Committee approached the Government and asked for a grant for the purchase of machinery, the erection of a building, and a site for its location. The Executive readily granted the request. A building which had been erected in Christchurch for use as a small-pox hospital last year, but which, fortunately, was not required, was handed over, and a grant of £250 made by the Legislature, and permission given for the erection of the building on its present site.

Sir Daniel Morris said it gave him great pleasure to respond, on behalf of his wife, for the vote of thanks which had been passed to her. There were other cotton factories in the West Indies, but this was the first central factory. Mr. Clarke had given a historical review of the starting of the cotton industry of Barbados and the West Indies, and he would say that the success the movement had so far met was due to the co-operation of the Agricultural Society with the Imperial Department, and to the grant and assistance given by the Legislature to the Cotton Cultivation Committee. The British Cotton Growing Association had presented them with a gin and a baling press, and two further gins of a similar character had also been promised. There was one point Mr. Clarke had omitted to mention. In addition to the gift of machines, the Association had made Barbados a grant of £100 to enable the Committee to start cultivation and to supply seed to planters free of cost. Thanks, then, to the efforts made by the Association, the Committee, and the Legislature, they were now in a position to deal with all the cotton that was likely to be grown in Barbados during the next twelve months. They estimated that 1,000 or 1,200 acres would be under cotton cultivation during the coming season. That should yield 300,000 lbs. clean cotton, and they would have the seed as well. A valuable oil was made from cotton seed, and the meal left after the oil was expressed was a nutritive food for cattle. He hoped the meal would be used locally and not exported, as in that way it would go back to the land, and so prevent the impoverishment that might otherwise take place. That however, was a question which would be settled later on. He thanked the Committee and all who had helped to carry on the work. He was certain the industry would grow, as there were large tracts of land suitable for growing cotton without interfering with the sugar cultivation. He hoped by this time next year to find them producing as good cotton as was grown in any part of the world. What had been already sent to England, he would mention, was valued higher than any other cotton from other places. The cotton passed through the gin had been grown at Kent plantation by Mr. Cameron. As they could see, the gin worked properly; not a seed was left in it, and the lint was

beautifully soft. There would be no trouble in cleaning. The cotton already grown in the island would be ginned and shipped to England as soon as possible, and they would then be in a position to say what were the prospects of cotton growing in the island.

THE ECONOMIC FUTURE OF ETHIOPIA.

Agricultural Ethiopia is divided into two parts, north and south, of which the imaginary line will follow about the lattitude of Adis-Abeba. North of this line lies old Ethiopia, with small landowners, who cultivate barley if they inhabit the table lands of average altitude, or cotton and coffee if they are near the deep, warm valleys. The agricultural productions of the Ethiopian table lands vary with their very different altitudes. The complete deforestation of the north gives a melancholy aspect to the landscape; the natives have cut down for building, or for firewood, all the trees, without making any attempt at replanting. In the vicinity of Adis-Abeba, for example, it is impossible to find any shade. The pasture lands stretch out indefinitely, with herds of cattle and horses, or flocks of sheep. At long intervals, the round huts of the natives may be seen grouped on the banks of a stream in the bottom of a valley; all around are fields of wheat, barley, and lentils, but live stock is the great resource of the people. In fact, in a country like Ethiopia, completely deprived of natural means of communication and not yet provided with railways, cereals and other produce of the soil can be sold only in the region where they grow, while herds of cattle can be taken to the trade centres, and even the ports of the Red Sea without great expense. Thus the country is furrowed with caravans of merchants who, according to the *Bulletin de Geographie Commerciale*, come to the small local markets to exchange cotton, cloths, silks, weapons, hardware, hats, and military stores, for coffee, cattle, sheep, horses, and mules. The Galla country, or Southern Ethiopia, does not present the monotony of vast undulating plains. The mountain groups which compose it are covered to their summits with bushy forests, and abound in picturesque sites. The number of valleys is very good; in fact, every little stream has hollowed out its valley, where everything seems to grow without cultivation. The marvellous richness of the soil is aided by abundant and regular rains, and by an ideal climate. The ground is said to yield, almost without cultivation, two crops a year. In the lowlands cotton flourishes, farther up on the slopes are fields of maize, sorghum, barley, wheat, lentils and beans. In the kitchen gardens, besides the usual vegetables—potatoes, onions, and peas—tobacco and cabbages are grown, the latter more than three feet high. Farther to the west, the country is richer, more cultivated, and more populous. For miles in the valleys of the Gabba, Godjibe, and Boro, there are only coffee trees. The undergrowth of the forests is entirely composed of coffee shrubs, and millions of pounds of excellent coffee ripen there every season. The natives gather only a small quantity, the rest falls and decays on the spot. Northern Ethiopia is already a consumer of manufactured articles. The people have a certain idea of comfort; living in a temperate country with cool nights, they are obliged to dress warmly; they buy woollen stuffs, cotton cloths, silks, &c., even hats and shoes. To profit by the natural wealth of this country, means of communication must be created. The Abyssinian plateau could be approached by railways on three sides—on the north-east a line could start for the Italian port of Massowah, on the north-west one could ascend the Blue Nile as far as Khartum, and on the east a line should run by Djibonti. Which one can most easily become the chief artery of trade? The line by Massowah would serve only the northern provinces; there remain Khartum and Djibonti. By Khartum, says the *Bulletin*, England could easily construct a railway the length of the Blue Nile, and then by the valley of the Didessa, penetrate to the heart of the table lands. This line would be well situated, but in order to have the traffic of the Gallas provinces it would have to be pushed as far as Léka. It would then be more than 620 miles long. But Djibonti is exactly 652 miles distant from Léka, in passing by Adis-Abeba, the capital of the empire—that is to say, merchandise over the Djibonti line would reach the Red Sea after a passage of 652 miles, while goods which would take the Khartum line, would, at the end of the same distance, be 1,516 miles from Alexandria and from the sea. Djibonti is the natural port of the central table lands of Ethiopia, and it is destined to be the distributing point for the products of the southern provinces, which have before them every prospect of prosperity.

VIENNA PORCELAIN.

The great Austrian porcelain manufactory that existed in Vienna for generations under State control, and by the aid of State subventions, was abolished in 1864, as commercially unsuccessful. It was, perhaps, the leading factor in bringing the ceramic industries of Austria into favour and importance. Upon the closing of the Government undertaking, the works were sold piecemeal, and the parts not acquired by the museums were bought by the public. In addition to the usual table services, the manufactory has made a great variety of decorated china groups that on account of their beautiful modelling, fine paste, and glaze, as well as rich colouring, gave the works perhaps their greatest fame. On the sale of the moulds in which these groups were formed, the most considerable and best portion was purchased by a local factory that made little or no use of them. Now, however, according to the American Consul-General at Vienna, after lying idle some forty years, the moulds have been taken up by the chief porcelain and faïence establishment in Vienna, and the manufacture of the old time groups, originally modelled by celebrated artists has begun again. The new work

cannot rightly be termed reproduction or copy. It is recoinage from old dies—a resumption of discontinued work. Save in age, there is no variation; paste and pigments are identical, and when the touch of time has mellowed the glaze, it will, it is said, be practically impossible to detect the difference between the figures of to-day, and those of the early period, except that the impressed shield on the bottom of each piece is now accompanied by a coronet. With the dissolution of the former works, the famous mark of a blue shield, dropped from the category of exclusive property, like Meissen or Sèvres, and became free to anyone who chose to employ it. Beyond its artistic and historical aspects this renaissance of a celebrated industry will have a market bearing on the ceramic trade of Austria.

CULTIVATION OF CANAIGRE IN MEXICO.

The cultivation of canaigre, a plant which is indigenous to some parts of the United States and Mexico, is the basis of a new industry. The amount of tannin that is used in the world is constantly increasing and has to be looked for in other plants than those already known. The principal substances that are used for tanning now are oak bark, hemlock bark, and sumach. Last year the United Kingdom alone used 136,284 tons of tanning substances, and in the United States the consumption amounted to 1,500,000 tons. The growing demand for leather also increases the demand for tan bark, and the visible supply is said to be deficient. The tanners and scientific men are, according to Consul Jerome, of Mexico City, looking in the chemical as well as in the vegetable kingdom for a new method to produce tannic acid, and this has been discovered in the root of the canaigre, the Latin name of which is *Rumex hymenosepalas*. The name canaigre is a corruption of caña aigre, meaning sour cane, a name given to the plant by the Mexicans. This plant is of bushy habit, growing to the height of from 15 inches to three feet, but having large tuberous roots, like sweet potatoes and of very much the same colour. It is handsome in appearance, and grows wild in the arid regions of New Mexico, Arizona, California, and Mexico, but nowhere does it attain such size as about 100 miles south of El Paso, where it grows in great profusion. It is a plant of slow growth, taking about five years to mature. The trouble heretofore has been that, after gathering the crop that grew wild, there was none to fall back upon, but before long this will be remedied, as several years ago the farmers around Deming planted many acres of canaigre. In 1898 the Department of Agriculture analysed the canaigre and found that the roots contained 35 per cent. of tannic acid. The result of this discovery was that a large shipment was sent to Germany, which arrived in bad condition as it fermented *en route*, but after many experiments the growers in Mexico have learned better how to handle it and thoroughly dry it before shipping.

Correspondence.

PORT OF CALCUTTA.

The late Mr. Horace Bell was very well known in Calcutta, and his excellent "Notes on the Ports and Harbours of Peninsular India," published in your *Journal* of July 17th, have naturally called attention to the facilities offered at the Port of Calcutta, a description of which was recently written for your *Journal* by Sir C. C. Stevens, at one time Chairman of the Port Commissioners.

Mr. Bell wrote of his first experience of Calcutta in 1863, when he arrived in a sailing vessel of from 800 to 900 tons, and said that the largest vessel that then came up the Hoogly could not have been much over 1,000 tons register.

It may interest readers of your *Journal* to know that vessels over 500 feet long, with a beam of just under 60 feet, and drawing 28 feet of water when loaded, now frequent the port. The largest of these vessels has a gross registered tonnage of 8,940 tons and carries over 11,000 tons of cargo, and 2,000 tons of bunker coal. As an example of what can be done in the way of handling cargo, it may be mentioned that the s.s. *Collegian* arrived at Saugor (the mouth of the Hoogly) on 28th June, proceeded 80 miles up to Calcutta, unloaded 8,350 tons of cargo, loaded again with 9,000 tons, and left Saugor on 10th July, doing the complete round trip, including the handling out and in of 17,350 tons of cargo in twelve days.

F. G. DUMAYNE, Vice-Chairman.
Commissioners for the Port of Calcutta.

August 6th, 1903.

General Notes.

SANITARY INSTITUTE.—The 36th course of lectures and demonstrations for sanitary officers will be given in September and November. The course comprises the following lectures:—In Part I., four on elementary physics and chemistry in relation to water, soil, air and ventilation, and meteorology, and twenty-one on public health statutes, the practical duties of a sanitary inspector, municipal hygiene or hygiene of communities, and building construction in its sanitary relations, local physical conditions; measurement and drawing plans to scale. Inspections and demonstrations are arranged in connection with the lectures, and include visits to disinfecting stations, dairy premises, municipal depôts, artizans' dwellings, offensive trades, waterworks, common lodging houses, sanitary works in progress, refuse and sewage disposal works. In Part II., seven lectures will be on meat and food inspection, including taking samples of water, food, and drugs, for analysis. The lectures at the Parkes Museum, Margaret-street, London, W., will commence on September 14th and end on November 25th.

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No. 2,650. Vol. LI.

FRIDAY, SEPTEMBER 4, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS, 1904.

These Examinations will commence on March 21st, 1904. The following is the Time Table :—

Monday, March 21 (7 to 10 p.m.).
Grade II. : — Arithmetic, German, Portuguese, Précis-writing, Russian, Chinese, Japanese.
Grade I. :—Arithmetic, German, and Typewriting (from 7.30 to 10 p.m.).

Tuesday, March 22 (7 to 10 p.m.).
Grade II. and Music : — Book-keeping, Italian, Spanish, Harmony.
Grade I. :—Handwriting and Correspondence, French.

Wednesday, March 23 (7 to 10 p.m.).
Grade II. and Music :—English, French, Commercial History and Geography, Typewriting (from 7.30 to 10 p.m.), Rudiments of Music (7 to 9 p.m.).
Grade I. :—Book-keeping, Spanish.

Thursday, March 24 (7 to 10 p.m.).
Grade II. :—Economics, Danish, Shorthand (from 7.30 to 10 p.m.).
Grade I. :—Shorthand (from 7.30 to 10 p.m.), Commercial Geography.

In the general Examinations (Grade II.), First, Second, and Third-class Certificates will be granted in each subject.

In the Preliminary Examinations (Grade I.), Certificates will be given in each of the subjects enumerated. These will be of one class only.

In Rudiments of Music Higher and Elementary Certificates are given. In Harmony Higher, Intermediate, and Elementary Certificates will be granted.

Certificates of proficiency will be granted in each Grade to Candidates who pass in certain specified subjects during a given period.

A Fee of 2s. 6d. will be required by the Society from each Candidate in each subject in Grade II., and in Grade I. a fee of 2s. for one subject, and 1s. for each additional subject taken up by the same candidate. The fees for Harmony and Rudiments of Music are the same as for Grade II.

Vivâ voce Examinations in French, German, Spanish, and Portuguese are held at any date, at any of the Society's examination centres, where the local Committee undertakes to make the necessary arrangements, and to pay a fee of 2s. 6d. per candidate, for not less than 24 candidates.

A Practical Examination in Vocal and Instrumental Music will be held in London, commencing on the 20th of June. In this Examination special fees are required.

A Society's Bronze Medal will be awarded to the candidate obtaining the highest marks in the First Class in each subject in the General Examinations (Grade II.), and in Harmony, if certified as proficient by the Examiner. These medals will only be awarded to natural born British subjects.

In any subject for which 100 candidates present themselves a second medal will be given. When there are 500 candidates in any subject a third medal will be given. For every additional 500 candidates another medal will be given.

A Society's Bronze Medal will be awarded to any candidate who passes with distinguished merit in the Vocal or Instrumental Examination in Music.

The Clothworkers' Company offer First, Second, and Third Prizes of £5, £3, and £2 respectively in each of the following subjects :—Italian, Spanish, Portuguese.

The Council of the Society offer a First Prize of £3, and a Second Prize of £2, in each of the other subjects, viz. :—Arithmetic, English, Book-keeping, Commercial History and Geography, Shorthand, Type-writing, Economics, Précis-writing, French, German, Russian, Danish, Chinese, Japanese, Harmony.

The prizes will only be awarded to candidates (natural born British subjects) who have taken First-class Certificates, and are certified as proficient by the Examiner in each subject.

The Council have accepted the offer of a scholarship made by the London School of Economics and Political Science for the most successful candidate in Economics. It will entitle the scholar to a course of training in

Economics or Political Science, extending over three years, and to free admission to all the lectures, &c., arranged at the school during that period.

The Examinations are under the control of Local Committees, a list of which will be found in the Programme.

Copies of the programme for 1904, with full details, together with the questions for 1903, and reports by the Examiners, can be had, price 3d., on application to the Secretary, Sir Henry Trueman Wood, Society of Arts, Adelphi, London, W.C.

The questions for the years 1896 to 1902 inclusive (with the exception of 1899), can also be obtained (price 3d. each year) on application as above.

Miscellaneous.

*THE RELATIONS BETWEEN SCIENTIFIC RESEARCH AND CHEMICAL INDUSTRY.**

In so many ways does chemistry come into contact with nearly every branch of industry, that it is difficult to know where to draw the line in giving actual illustrations of the industrial results achieved through chemical research. It is not possible logically, for example, to distinguish between the results obtained through research directed towards the solution of a particular industrial problem and the results obtained as by-products in the course of purely scientific investigation. Industry has been advanced, and always will be advanced, by both methods. Bearing in mind also that chemistry, in its widest sense, is essentially the science of matter—at any rate until the physicist has electrified matters into his own demain—it is evident that we are concerned not only with the production of useful materials for direct consumption, but also with the production of materials required in other industries. Thus chemistry affects engineers through the metals, cements, and other materials used for constructive purposes, and through the fuels used as sources of energy; it affects the agriculturist on account of the relationship between the growing plant and the composition of the soil, as well as through the relationship of the composition of crops and their value as food-stuffs; it supplies materials for the pharmacist, for the manufacture of pottery, glass and soap, for the paper-maker, for the dyer and colour-printer, for the bleacher, tanner, brewer, and spirit distiller; it furnishes the explosives used in modern warfare, and it supplies photography with all the materials necessary for the practise of that art. Among later developments, it may be claimed that the modern science of bacteriology is the outcome of chemical research, and the manufacture of antitoxins—the industrial result of this science—has, until quite recently, been in the hands of the chemical manufacturers. I may remind you also that many important products, such as sodium, aluminium, phosphorus, calcium carbide, caustic soda, and chlorine, are manufactured by electrical processes, so that the demand for these products has given an impetus to the development of applied electricity.

It is obviously impossible in view of the enormous range of industry in which chemistry is directly or indirectly concerned to do more on the present occasion than take a cursory glance at a few of the more striking cases illustrative of the connection between research and industry. As an example of the creation of an industry through research directed towards a special end, attention may be directed to the manufacture of optical and other glass at Jena. The history of this branch of manufacture, and the results achieved, have been fully described by Dr. Hovestadt in a work published three years ago, and of which a translation, by Prof. and Miss Everett, has been recently published in this country. I must refer you to this work for full particulars. The physical requirements to be complied with in order to produce the most perfect glass for the construction of lenses for optical instruments had long been known, and many attempts had been made to realise these conditions in practice. A visit to the international exhibition of scientific apparatus in London in 1876 led Prof. Abbe to direct attention once again to the fact that the future perfection of the microscope lay with the glassmaker, and in 1881 he, in conjunction with Schott, commenced a set of experiments having for their object the production of a series of glasses of known composition, the optical properties of which were concurrently determined by measurements made by Prof. Abbe. The experimental meltings were enlarged in scale the following year, and an experimental laboratory established for the continuation of the work at Jena. A chemist was added to the staff, and thus there were co-operating in this industrial research a glassmaker, a chemist, and a physicist. Before the end of 1881 the results had been so far successful that the Jena laboratory was in a position to make known to the world the processes for the "rational manufacture of optical glass." At this stage the experimenters were persuaded to put the results of their labour into practice, and the instrument makers, Messrs. Zeiss, having joined in, the Jena glass factory for producing optical glass on the commercial scale was established towards the end of 1884. In the first catalogue published by the Jena Works in 1886, we are told that 44 optical glasses, 19 being new in composition, were included. By 1888 the undertaking had been so successful that a supplementary catalogue was issued containing twenty-four additional

* Extracted from a lecture delivered at the University Extension Meeting at Oxford on August 3, by Prof. Raphael Meldola, F.R.S. The lecture is printed in full in *Nature* for August 27.

glasses, of which thirteen were new, and in 1892 a second supplement announced the manufacture of eight more kinds of glass, of which six were new. Consider what this piece of work, prompted by science, fostered by the State, and carried out by a university professor in conjunction with a technologist has done for German industry. In the early stages of the experiments, before commercial results had been obtained, the experimenters were subsidised by the Prussian Education Department and by the Prussian Diet, with a wise forethought which subsequent events have amply justified. Need I remind those who have come here to hear about bacteriology from Professor Sims Woodhead how that science has advanced *pari passu* with the perfecting of the microscopic objective? The Zeiss instruments are now world-renowned, for it is obvious that a command over the processes for making glass with any particular optical properties that might be desired would enable the instrument maker to produce lenses suitable for other purposes, such as telescopes, field-glasses, photographic cameras, &c. I am afraid to dwell too much upon the perfection of the lenses of the Jena instruments, because I lay myself open to the charge of holding a brief for a particular firm. If you want to know more fully what this optical glass industry has done for Germany, I refer you to the report on instruments of precision published in connection with the German exhibit at the Paris International Exhibition of 1900. As a further outcome the study of the properties of glasses of known composition in connection with the thermal and electrical behaviour has led to the manufacture of glass especially suitable for making thermometers, as also for electrical insulation, for the construction of the vacuum tubes used for producing Röntgen rays, and for the vessels employed in chemical laboratories. In brief, the manufacture of the finer kinds of glass has been placed upon a strictly scientific footing as the outcome of scientific research.

The next illustration which I propose to make use of refers to the applications of chemistry to agriculture. The growing plant, as you are aware, requires food for its growth just as much as the growing animal. Take an extreme case, and consider the size and weight of an oak tree as compared with the acorn from which it arose. This enormous accumulation of matter represents the assimilation of gaseous food in the form of carbon dioxide from the air through the leaves, and of water and nitrogenous and other mineral matter through the roots. It was the great German chemist Liebig who first established this broad principle of plant growth by systematic experiments upon various crops, and his results were given to the world in a work published in 1840. It is evident that if a growing plant requires certain elements, such as potassium, sodium, phosphorus, nitrogen, calcium, magnesium, sulphur, chlorine, iron, &c., and if the soil by previous crops has been exhausted of some of these elements, it will not be possible to raise subsequent crops on this impoverished soil unless the necessary elements are supplied. In other words, the requisite elements must be added, and added in the form of compounds which the plant can make use of. Thus the great industry of crop-raising, and as connected therewith the feeding of farm stock, was shown to depend ultimately upon the chemical composition of the soil, and the manufacture of artificial manures or fertilisers has been the practical outcome of Liebig's researches.

Let us consider, further, the industrial results so far as these have influenced chemical manufactures. The elements which are most likely to fail, and which, in fact, have generally to be supplied, are potassium, phosphorus and nitrogen, excepting, of course, in the case of those particular leguminous plants which have developed a special means of fixing atmospheric nitrogen. Chemistry having thus been called upon to supply the agriculturist with compounds containing potassium, phosphorus and nitrogen, the first development which may be ascribed to Liebig's influence is the Stassfurt salt industry in Prussia, where immense deposits of salt containing potassium were known to exist. Similar deposits are found in Anhalt. The mining of these salts was commenced in 1860, and has proved an immense source of wealth to Germany, the total value of the Stassfurt and Anhalt salts produced down to 1890 being estimated at £11,500,000, and since that time the output has gone on increasing from year to year. The Stassfurt salt factories are now supplying Germany, as well as exporting large quantities of potassium chloride and sulphate, magnesium chloride and sulphate, potassium carbonate, caustic potash, &c.

In a similar way the demand for phosphates has given rise to the utilisation of every available source of these compounds. Calcium phosphate in found as the mineral apatite, a double calcium phosphate and chloride or fluoride occurring in vast deposits in America, and also in a less definite form in Canada, the West Indies, France, Belgium, and Germany. In this country calcium phosphate occurs in the form of coprolites, supposed to be the excreta of extinct saurians, in Cambridgeshire and elsewhere. All these natural phosphatic mineral deposits are mined, and have become valuable assets to the countries possessing them. The conversion of the minerals into a form suitable for the nutrition of crops is a branch of chemical industry involving the use of sulphuric acid for the conversion of the natural phosphate into the more easily assimilable form known as superphosphate. The greater part of the world's output of natural phosphates finds its way to Germany to undergo this treatment, the annual consumption of artificial manure in that country being estimated at something more than two million tons at a cost of about £5,000,000. The mineral portion of the bones of animals, as you are no doubt aware, also consists largely of calcium phosphate, and before the mining of the mineral phosphates the conversion of bone ash into superphosphate was carried on on a very large scale. Bone ash is supplied now in large quantities from South

America, but not much is converted into superphosphate, as the bones, after removal of the fat and the size (for glue), are capable of being finely ground, and are available for manure in this form.

Here is surely a romance of chemistry! The phosphates contained in the vegetation of the South American pampas go to build up the bony framework of the cattle which graze thereon. The skeletons of these beasts ultimately supply, let us say, the growing crop of a beet sugar manufacturer in Germany with phosphates. The phosphates picked out of the soil by South American vegetation concentrate in the bones of cattle, and are then sent into circulation in German beet. Or, even more striking, the phosphates accumulated by the great lizards of a remote geological age are now circulating through growing crops.

But we must descend from romance to reality. The deposits of sea birds also contain phosphates derived from the fish upon which they feed, and these deposits often accumulate in such large quantities as to make them available for agricultural purposes. Under the name of guano, immense quantities of this material, which contains both phosphates and nitrogenous matter, and exported from Peru. There is subject-matter for philosophising here, also, about the circulation of phosphates from marine organisms through birds into growing crops, and so forth, but time will not admit of many side disquisitions if I am to keep to my text. As another source of phosphate, it is of interest to know that the basic slag obtained in the Thomas-Gilchrist process of making steel is now largely used, so that the work set going by Liebig has, among its latest developments, led to the utilisation of a waste product of the steel industry.

The ordinary source of nitrogen for growing plants is a soluble nitrate, and if the soil is poor in such salts, they must be supplied either directly or indirectly through salts of ammonia, which are converted into nitrates in the soil by bacterial action. The great natural deposits of sodium nitrate which occur in Chile and Peru supply practically all the nitrogen applied to the soil in this form for fertilising purposes. With respect to ammonia, the destructive distillation of coal for the manufacture of gas and tar products, or for the production of coke, furnishes practically all the salts of this base required for agricultural and other purposes. The vital importance of assimilable nitrogen to growing crops has led the chemist also to study methods for the fixation of atmospheric nitrogen so as to render this element available for such purposes. It has long been known that nitrogen and oxygen can be made to combine under the influence of the electric spark. This, as you may remember, is one of the methods used by Cavendish in his classical researches on the composition of the air, and it was used also by Lord Rayleigh to separate atmospheric nitrogen from argon. Sir William Crookes has shown that the combustion can be brought about by the electric flame with such facility as to render the production of nitrite and nitrate by this process an industrial possibility, and the manufacture has actually been started in America by utilising the Falls of Niagara for the generation of the necessary electric power. Still more recently it has been found by Caro and Frank that when lime and coal are heated in the electric furnace, the calcium carbide fixes atmospheric nitrogen to form a compound known as calcium cyanamide, and this decomposes in the soil with the liberation of ammonia, so that the nitrogen of the air is thus rendered available for plant nutrition by an electro-chemical process. The manufacture of this "Kalstickstoff" is in the hands of the electrical engineering firm of Siemens and Halske, in Berlin.

Equally instructive as illustrating the connection between scientific research and industry is the production of alcohol and other valuable products through the agency of living organisms. The spontaneous conversion of saccharine solutions, such as the juice of the grape, into solutions containing alcohol, with the concurrent development of gaseous carbon-dioxide, is among the earliest recorded observations in applied organic chemistry. The various theories which were from time to time advanced to explain what is called "fermentation" are now of historical interest only. It is to the researches of Pasteur that we are indebted for the placing of the fermentation industries on a scientific foundation. This illustrious chemist, who as far back as 1860-62 had successfully disproved the so-called "spontaneous generation" by showing that the ordinary air was always charged with living germs, turned his attention to the diseases of wine, with the object of assisting an inductry of great national importance in France. His "Etudes sur le Vin" was published in 1872. A greater work—the great classic of the science of fermentation—appeared in 1876 under the title of "Etudes sur la Bière." In this work it was definitely proved that the transformation of sugar into alcohol is a biochemical change; that the yeast which produces this change, and of which the organised nature had long previously been suspected, is, in fact, a low form of vegetable life allied to the fungi, and that it multiplies and grows at the expense of the sugar and other materials contained in the fermenting liquid, the alcohol and carbon-dioxide being the products of its activity. It is now known, through the work of Buchner, that this chemical transformation of sugar into carbon-dioxide and alcohol is the result of interaction between the sugar and a certain definite substance—an unorganised ferment—which is formed by the living yeast shell, and which can do its work independently of the cell in which it originated.

The scientific development of the fermentation industries followed from this and other work of Pasteur's. The names of those who have taken part in the latter developments are numerous and illustrious, but want of time prohibits a detailed survey of this most fascinating chapter of biochemistry. The leading idea that the formation of alcohol is a biochemical process depending upon

certain organisms, or, as we may now say, upon the products of certain organisms, carries with it, as a necessary consequence, the conclusion that the industrial production of alcohol—whether for brewing or spirit distilling, or for the chemical manufacturer—is not an empirical or rule-of-thumb operation depending upon unknown conditions, but a definite chemical change produced in a definite way, by a definite organism (yeast), and is just as much under control as any other chemical operation. The chemist and the brewer have thus also been brought into association. Keeping to the main topic of industrial results, one outcome has been, as I have said, to bring the operations of the brewer under scientific control. The organism, the yeast introduced into the vat to induce fermentation, must undergo careful microscopic examination to see that it contains no deleterious organisms, *i.e.*, no organisms which would give rise to products other than alcohol. The water used by the brewer must be analysed to ascertain whether it contains the necessary mineral constituents for the nourishment of the yeast, because this plant is subject to the same conditions of growth as any other plant. Instead of obtaining its carbon from carbon dioxide, however, it can utilise sugar for this purpose, and it decomposes the sugar into carbon dioxide and alcohol in the way indicated.

The recognition of yeast as a vital chemical reagent which is apt to contain impurities in the form of wild or stray organisms which may damage the contents of the brewing vat, has led further to the introduction of the process of brewing by what is known as "pure culture yeast." This industry, of which the home is chiefly on the Continent, depends on the use of a yeast cultivated in the first place from a single cell of some particular species or variety or race by methods similar in principle to those adopted by the bacteriologist, the cultivation being carried on from generation to generation in carefully prepared solutions containing the necessary nutrient materials, sugar, nitrogenous matter, mineral salts, &c., and previously sterilised by heat so as to destroy every other form of life. The brewer can now be supplied, as the outcome of a series of brilliant investigations by Hansen, of Copenhagen, to whom he is indebted for this purification of the biological foundation of his industry, with a cultivated yeast as pure in strain as a pedigree horse or a particular breed of dog—a yeast which, by virtue of its purity, can be depended on for giving constant results in the brewing vat. This is another illustration of the relationship between research and industry.

Consider, in the next place, the sugar which the yeast decomposes by virtue of its zymase. In an ordinary brewing operation, the liquor which is fermented is not supplied in the first place with sugar as such, but the starch contained in the barley grain is ultimately broken down, as chemists say, into sugar, by virtue of certain processes which I cannot stop to explain. But the broad fact is that yeast cannot feed upon starch, but only upon sugar, and, in fact, only upon certain kinds of sugars, and the starch which is stored up in the barley is the raw material which ultimately supplies the necessary kind of sugar. So that starch, which, as you know, is a substance very widely distributed in the vegetable kingdom, can be extracted if necessary from the seeds or tubers which contain it, and converted into sugar by chemical processes, and then used for the production of alcohol. An important industry is flourishing in Germany at the present time for the production of alcohol from potato starch. In Berlin, a few weeks ago, we were shown over a large establishment entirely devoted to the fermentation industries, and potato spirit and other products from the potato were the most conspiccuous features of the exhibition. Now alcohol is a substance of great importance for chemical industry in many directions, and its inflammability makes it valuable as a fuel, so that the problem of the cheap production of alcohol is worthy of the serious attention of investigators. It is interesting to contemplate the period when our natural sources of fuel, coal and petroleum are all exhausted, and when we may have to fall back upon the vital activity of a lowly form of vegetable life to supply us with liquid fuel. Scientific research has helped here, also, to call a new industry into existence, because the cost of alcohol, like that of any other chemical product, is obviously dependent upon the yield, *i.e.*, upon the quantity obtainable from a given weight of raw material.

It had long been known that in Java an alcoholic beverage, known as arrack, was prepared by fermenting molasses with a peculiar ferment prepared by a special process from rice. From what has been previously said, you will understand that the starch contained in rice, is not, as such, available for direct alcoholic fermentation. A detailed scientific investigation of the starch-fermenting materials used in Java and elsewhere in the Far East has revealed the fact that these ferments owe their activity to the joint action of two out of several different organisms which are contained in them. One of these is a mould fungus which has the property of saccharifying starch, *i.e.*, breaking it down into sugar, and thus rendering it available for the growth of the other organism, which is a yeast capable of exciting alcoholic fermentation in the usual way. Now the principle revealed by the scientific study of these eastern ferments has been developed into an industrial process for producing alcohol from starch of any origin, such as from maize, rice, potato, &c. The operations, in the briefest possible terms, consist in saccharifying the prepared starch by a pure culture of mould fungus, and then fermenting by means of yeast. The problem of increasing the yield of alcohol has thus been solved; not only is the spirit obtained in more concentrated form, but the actual percentage of alcohol furnished by a given weight of starch is much greater than has ever been obtained by any of the older processes of fermentation.

I have left but little time for dealing with an industry with which I have had long personal connection—the manufacture of colouring matters and other products from coal tar. The relations between scientific research and this industry are so intimate, and so frequently referred to in public, that it has become a kind of stock example for the use of those who wish to emphasise the interdependence of science and industry. The history of this industry, moreover, is particularly instructive from our present point of view, because it originated in this country in 1858, and flourished here for a period of about twenty years, and then began to decline. The chief centre of activity for the production of coal tar products at the present time is Germany, where there are six large factories and a number of smaller ones. The aggregate capital of the six large factories amounts to some £3,000,000, and they give employment to about 20,000 people, including chemists, engineers, clerks and travellers, dyers and draughtsmen, workmen, &c. These large firms pay dividends varying between 5 and 25 per cent. upon their capital. The total value of the tar products manufactured in Germany exceeds £10,000,000 annually, and she supplies by far the largest proportion of the dye-stuffs used throughout the world. When, in 1866, I proclaimed our approaching fate with respect to this industry, I found that we were then using about 90 per cent. of German and other foreign colouring matters in this country, and my friend, Prof. Arthur Green, of the Yorkshire College, finds that things are in about the same state at the present time.

The coal tar colour industry arose, in the first place, from an observation made by Dr. W. H. Perkin in 1856, in the course of a research having for its object the synthesis of quinine. He did not succeed in producing the alkaloid, but he noticed that aniline, when oxidised, gave a colouring matter, which he manufactured and introduced under the name of "mauve," and so laid the foundations of an industry which has developed to its present colossal dimensions. The art of the dyer and calico-printer has been absolutely revolutionised by the introduction of the synthetical colouring matters prepared from coal tar. Of these more than 500 are now available—each one a distinct and definite chamical compound with characteristic colour; each one with properties rendering it suitable for application to particular classes of fabrics. Every range of colour, including the deepest black, can be imparted, and every degree of brilliancy or dullness, of fastness to light, to washing and bleaching agents, &c., can be realised as required. The natural dye-stuffs, such as madder, which supplied alizarin for Turkey red; the cochineal insect, which furnished a red dye; the lichens and dyewoods, which were used by the old-time dyers, have been displaced, or are on the way to displacement, by the tar products. The most important of all the natural colouring matters, indigo is, as you know, among the latest of the achievements of industrial synthetical chemistry, and a great industry worth some £3,000,000 annually to our Indian Empire is threatened with extermination by the German manufacturers. Not a month passes without the introduction of new colouring matters, and so enterprising are the German colour makers that their pattern-books are issued with full directions in various languages, and trained chemists in their service will give personal instructions to our dyers in the application of new and unfamiliar colouring matters.

It is impossible to do more that allude in passing to the enormous influence of this greatest and most refined of all the chemical industries upon every other department of chemical manufacture. It has reacted, and is reacting, with ever multiplying ramifications upon the manufacture of the raw materials, such as acids and alkalis, it is revolutionising the methods for producing sulphuric acid, it is pressing into its service electrolytic processes, and it has created new branches of engineering for the construction of special plant and machinery. The utilisation of the infinity of compounds present in the tar is no longer restricted to the production of colouring matters. Valuable medicinal preparations, photographic materials, perfumes, antiseptics, the sweet tasting saccharin, which is 300 times sweeter than sugar, an artificial musk which exceeds in intensity of odour any natural musk, are among the manufactured products from coal tar. The industry is the direct outcome of scientific research, it has been developed by research, and is being still developed by research. Both methods referred to in this address have been and are, at work. The by-results of pure scientific investigation are seized upon whenever they show the slightest chance of being industrially useful. Saccharin is such a by-result. The chemical reactions which culminated in the industrial production of indigo were published by their discoverer, the late Dr. Heumann, as an academic discovery in the first place, and were developed industrially by the "Badische Anilin und Soda Fabrik" of Ludwigshafen. By the other method, whole armies of highly-trained scientific chemists are constantly at work in the splendidly-equipped research laboratories of the German factories investigating new products and processes with the direct object of their ultimate industrial application. Nor must it be forgotten, that under the term "research" used in this connection is comprised also theoretical research. A close study of the history of this industry will show how throughout it has been vitalised by theoretical conceptions concerning the chemical structure of the molecules of organic compounds, and especially by the so-called benzene ring theory of Kekulé, now so familiar to chemical students. The force of illustration of the connection between science and industry can, perhaps, go no further than in this case, where a purely abstract conception, based on a knowledge of the properties of the atom of carbon, has reacted upon a branch of manufacture to its lasting benefit.

THE CYDER INDUSTRY IN DEVONSHIRE.

In 1895, the question of the development of the cyder manufacture in this country was brought before the Society of Arts, in a paper read by Mr. C. W. Radcliffe Cooke, and published in the *Journal* for March 8th of that year. This paper dealt more particularly with the industry in the county of Hereford, but since that period a great deal of attention has been given to the revival of the manufacture generally in all the apple-growing counties of England, the chief of which are, of course, Devon, Hereford, Somerset, Worcester, and Gloucester.

An industry of this kind, founded entirely on British produce, and capable, if promoted in the right direction, of extensive development, and of finding employment for a large number of hands—both men and women—amidst healthy surroundings in rural districts, would undoubtedly prove an important factor in the effort to "bring back to the land" those who have strayed from it.

If the girls in our congested cities and boroughs are to be taught poultry and dairy farming, which are amongst the new schemes of some of the metropolitan borough councils, it seems equally appropriate and necessary that the boys should be taught how to grow good apples, which is the first step towards the production of good cyder. Practical gardening or horticulture is already on the list of subjects upon which lectures are given by qualified persons under the several county councils, and in apple-growing districts special attention might be given not only to the culture of the fruit for domestic purposes, but also to those varieties that are of especial value for cyder.

It has been proposed, as a means of extending the cyder industry, that farmers who have any extent of apple orchards attached to their farms should receive instruction both in the best methods of apple culture, and also in the most approved principles of cyder making. This, however, does not commend itself as being the best means of promoting the end in view. To perfect and extend the cultivation of suitable kinds of fruits, with special attention to those that have proved of the greatest value to practical cyder makers, to give great care to the health of the trees by a proper system of pruning and cleaning, by which means alone can insect and fungoid attacks be prevented, and good healthy crops be ensured, seems to belong exclusively to the farmer's operations, and under such a system the orchards of Devon might be made much more profitable than they are at present, for what is particularly striking at the present day in passing acres upon acres of apple orchards in this favoured county is their generally neglected appearance. Most of the trees are very old, and the trunks and branches are covered with a thick growth of lichen or ivy. This, together with the fact that in an abundant apple season the fruits are often left in heaps upon the ground till they are well nigh rotten, goes far towards inducing people to believe that cyder is anything but a wholesome drink. To counteract this feeling of suspicion it would be well for the apple grower to stick closely to the production of the best varieties of fruit, and to dispose of his produce to the practical cyder maker who knows by experience what varieties of apple produce the best English wine—a term that is now being applied to the best qualities of this home product. In addition to this, a well appointed cyder factory has all the most modern improvements in the machinery, and the expert knowledge gained by constant attention and employment in the one branch, not only by those possessing the scientific knowledge to conduct such operations, but also by the whole of the *employés* according to their degree in their separate departments. These remarks are not intended to mean that the growth of fruit, and the management of orchards cannot be combined with the manufacture of cyder, for the two can well be run together, but as a rule it would be far more satisfactory for the farmer to give an undivided attention to the production of the best fruit and dispose of it to the cyder maker, who in his turn would give special attention to his own business, with results that could not fail to be satisfactory to the grower, maker, and consumer. In the cultivation of other fruit such as strawberries, gooseberries, plums, &c., the grower on a large scale disposes of his crops to the jam-maker, and but few convert it into jam themselves.

For the purpose of making myself acquainted with the actual facts concerning cyder-making in Devon, I recently applied to Messrs. Henry Whiteway and Co., of Whimple, for permission to visit their works, and am indebted to them for furnishing me with some of the information contained in this article. In a little booklet issued by them they remark that if the cyder maker of to-day wishes to succeed in finding a market for his goods he must proceed on different lines from those of his forefathers, and call in science to assist his practical knowledge. In years gone by and even now the same opinion is widely held that farmers think anything in the shape of an apple good enough to make cyder, and it mattered not if it were green, ripe or rotten, bitter, sweet or sour, and the sight of a load of apples going to the mill was enough to give a sensitive person a decided feeling of nausea. Then, too, the old cyder press was not always particularly clean. Straw, very often mildewed or old smelling, was employed to place between the layers of pulp, imparting a musty flavour to the liquor, which never left it again. The juice was then put into casks, frequently in the same condition as the straw, and perhaps never touched again before it was required to drink, when it was called cyder, but it would have taken an exceedingly keen palate to distinguish it from vinegar. Such was the cyder and its system of manufacture in former days, a system that was quite sufficient to do away with any industry connected with the preparation of food or drink. The methods adopted by the modern cyder maker have to be conducted on different lines. "He must study the nature of the different varieties of apples,

and make himself acquainted with the effect the juice of one sort will have on another, so that they may be properly blended."

The apples, when ripe and mellow, are brought to the mill quite fresh from the orchards, and conveyed to the grinding or pulping machine at once, being carried up in pails by a revolving machine, somewhat like a Thames dredger, and tipped over into the hopper, not unlike that of a coffee-mill. In this they are ground into pulp at once. If wet weather prevails at the time of the delivery of the apples at the works, they are cleansed by steam or water jets before being put into the mill. When thoroughly reduced to pulp it is removed and placed in large, open wooden vats, where it is allowed to remain for some time, being occasionally stirred, so that all parts of the apple may become intimately mixed, and may react on each other, and further, that the valuable constituents of the fruit may become more soluble and be liberated with the juice. A change also takes place in the colour of the juice itself, from a watery whiteness to a rich sherry colour. The pulp is now ready for the press, which consists of a huge wooden erection, with a powerful screw top. Wooden frames, composed of strips of wood crossing each other lattice fashion, are placed under the powerful screw, and alternately between them cloths, made of Manilla hemp, are put, and upon these the pulp is placed. The screw being brought to bear upon this mass soon causes the juice to exude, and being collected in a trough below is conveyed into huge tanks, the bottoms and sides of which are glazed to ensure perfect cleanliness. From these tanks the liquor is pumped into casks, and placed in cellars, where very careful attention has to be given to temperature. Natural fermentation now proceeds—a critical period in the life history of cyder, and if this all important chemical action is not carefully watched and properly regulated, failure, instead of success, results. But one great object in this operation is to separate all impurities from the juice, which nature first throws to the top in the form of scum, and then precipitates to the bottom as dregs leaving the cyder perfectly clear and bright, and when sufficiently fermented it is in a fit condition to bottle. That all the operations connected with cyder making as shewn and described to me are conducted on the lines of perfect cleanliness is at once apparent, and will go far to establish cyder as a perfectly pure and wholesome English drink for English people. Every part of the mill, the woodwork of the presses and the cloths are constantly thoroughly washed and cleansed. The vats, casks, and bottles are also subjected to a system of cleansing by the aid of steam and water in a manner at once quick and efficient. Thus, for instance, I saw a cask into which a powerful steam jet was passed, followed by an equally powerful jet of water with such force that no impurities could possibly remain. A similar treatment of water force was passed into an inverted bottle, where at the same time a brush revolved rapidly so as to completely scrub every part of the inside. The filling of the bottles, corking, wiring, covering the corks and necks of the bottles with silver or gold foil, as in the case of champagne, and the labelling, are various processes which follow each other in rapid succession, and all of which are either completed or greatly assisted by modern machinery, the wiring process being worthy of note, as the wire, though perfectly secure, is not so tightly twisted as to require a corkscrew to untwist it, but a loop is made which is easily turned by the thumb and finger, so that the wire can at once be removed entirely from the neck of the bottle. With the aid of the machine, fifty bottles can be wired per minute. The lighter work, such as putting the foils over the corks, the labelling, &c., is executed by women and girls, so that this factory, situated close to the railway station and in the open country, gives healthy employment to a number of the villagers. In seasons like the present, when orchard after orchard in this part of the county scarcely contains a single apple, the loss to the farmers and cyder makers is, of course, very great, and would be still greater were it not that good and pure cyder can be kept almost for an indefinite period and, moreover, improves by keeping, so that in abundant apple seasons, a cyder maker, of any importance, has immense storage cellars where, as was shown at Whimple, tiers upon tiers of casks, varying from six gallons to sixty gallons each, besides from 14,000 to 15,000 dozen bottles were stored, so that while the deficient apple crop will seriously affect the villagers who depend so much upon them as a winter fruit, the cyder maker will be able to meet the demand, which though smaller in the winter than in the summer is always and increasingly in request owing, no doubt in some measure, to the fact that the medical profession of late has strongly recommended cyder, in gout, rheumatism, and kindred complaints, but to be of value from a medical point, the drink should be pure. It is a well known fact that of the different varieties of apples cultivated for cyder purposes, some are much more in favour than others. The difference in the quality and flavour of the cyder is very great. Thus, from the well-known variety of fruit known as the "Sweet Alfred," is produced a delicious wine of a rich and full flavour peculiar to itself; while, from another variety, called the "Fair Maid of Devon," a cyder is produced of the character of hock, for which wine indeed it is recommended as a substitute at dinner. In the blended cyders—that is from the combination of the juices of two or more varieties of apple—some of the finest qualities are produced, such as that known as the "Whimple Pomona," and another the "Woodbine Blend," which is the produce of two well-known varieties of Devon apples, producing a drink of a champagne character.

As a winter drink mulled cyder is strongly recommended, and for a cold a tumbler of hot mulled cyder taken just before going to bed is said to be most efficacious.

JOHN R. JACKSON.

SEEBPORE COAL.

In Professor Dunstan's paper on the "Coal Resources of India" (1902) there is a Table giving the results of an analysis of various qualities of Indian coal (see *ante*, vol. l., p. 395). The following report to Messrs. Andrew Yule and Co., of Calcutta, by Mr. Frederick Grover, A.M.Inst.C.E., which has just been published, contains fuller information with reference to Seebpore coal:—

According to your instructions, I made a practical test of your Seebpore coal [Bengal] by burning it in a range of six Lancashire boilers, each 8 ft. diameter and 30 ft. long. Two specially graduated tanks, of a capacity of 570 gallons each, were arranged for the accurate measurement of the feed water. All connections between the feed tanks and the boiler were seen to be tight. The feed pump glands were also frequently observed and found to be working without leakage. The water levels in the boilers were the same at the end as at the commencement of the test.

The coal and ash weightments were made on a standard Avery scale, the coal being weighed in bags holding two maunds, and the number of bags passed to the stokers was tallied at the weighing machine and again at the stokehold. The weight of the bags was deducted.

Before the commencement of the test, the fires were cleaned and afterwards fired with unweighed coal until they were in their normal condition. The firing floors were then cleared of all coal, and only weighed coal afterwards tipped on the floors. The duration of the test was, approximately, six hours, the exact termination being noted when the water gauges were brought to their original working levels.

In reading the results of the test which are appended, it must be borne in mind that the evaporation of a boiler depends upon (1) the quality of coal, and (2) the efficiency of the boiler plant. An excellent quality of coal used in an inferior boiler plant must necessarily yield low results. In the present instance, it will be noted that the efficiency of the plant, which includes the preliminary heating of the feed water by the exhaust steam, also the subsequent heating of the feed in passing through the Economiser, works out to be 73 per cent. Tests communicated by the late Mr. Bryan Donkin show, in some insrances, a total efficiency approaching 78 per cent. Had such conditions been at my disposal the evaporation would have been 8·5 pounds of water per pound of coal, instead of 7·97 as recorded.

The percentage of ash drawn from the fires worked out to a net weight of 16·7 of the original weight of the fuel. From the calorimeter tests, of which several have been made, it will be noted that the ash so obtained works out to 11·5 per cent. It has been my experience that the ash drawn from the furnaces invariably exceeds that obtained from the calorimeter tests. As one out of many instances, I may quote one of my own tests made with the Nottingham coal, fired by means of a mechanical stoker of such construction that it was impossible for large masses of unburnt coal to pass into the ash pit. Such an arrangement should, of course, bring the figures under discussion into closer correspondence, but in spite of this the calorimeter yielded 11·8 per cent. of ash, whilst the weight drawn from the fires was 17·2, this being a difference of 5·4 per cent. The reason for this marked difference is easily understood, when one reflects that the so-called ash drawn from the fires is largely obtained by raking and cleaning the fires, which necessarily causes a considerable downfall of small particles of combustible matter, too closely associated with the actual ash to be distinguished from it. In the calorimeter test, the excessive supply of oxygen, intermixed as it is with the finely-powdered fuel forming the calorimeter charge, is continued until every particle of combustible matter is consumed. The point is easily demonstrated by testing the calorific power of the ashes drawn from the furnaces, when they will invariably be found to have a small, though appreciable, heat value, thus proving the inclusion of combustible matter among the true ash.

In this connection, a point with reference to the smoke may be noted. It is, of course, desirable in all boiler plants to keep down the smoke to a minimum. Wide air spaces between the fire bars tend towards this reduction of smoke. Such additional width necessarily increases the loss of carbon in the ash. Hence there is some advantage to be gained by the use of a coal such as Seebpore, which burns freely without excessive smoke, and consequently without such wide air spaces as would otherwise be necessary.

Observation made in regard to the smoke showed that this was at no time excessive, and, for the greater part of the test, of a light grey colour, by no means objectionable. The test shows clearly that Seebpore coal can be burnt up to 20 lbs. per square foot of grate (if not more), with a chimney draught of 1 in. and a flue draught of $\frac{3}{4}$ in. of water, without experiencing difficulty with regard to the emission of smoke from the chimney.

My connection with the factories in and about Calcutta has freequently brought me in contact with Seebpore coal.

From my own personal knowledge I can state that the following factories are using Seebpore coal in quantities of 600 to 1,800 tons per month:—Cossipore Foundry and Shell Factory have a three years' contract recently placed, after five years' experience and testing of Seebpore coal; Dum Dum Factory; the Delta Jute Mills have used Seebpore for six years; the Howrah Jute Mills, after testing coal at a less price, are again using Seebpore; Budge Budge Jute Mills; the Bengal Cotton Mills; the Portland Cement Works.

A number of other users have been brought to my notice, amongst which are—The Halsi Bagan Flour Mills, Ralli Brothers Jute Press, and the Bombay, Baroda and Central India Railway.

In deciding the contracts for coal to be used in the

Cossipore Government Factory, a number of Indian coals were tested with a view to securing the best value, and it is a sufficient testimonial to the good qualities of Seebpore coal that the contract has been secured for this coal up to 1906.

Many of the Indian coals contain an abnormal quantity of ash, and this fact, coupled with long distances of transport, render it of the utmost importance to buyers to realise that the price paid into wagons is no criterion of the real value of the fuel.

To make this clear, let—

C equal the proportion of combustlble matter, namely, approximate 1, minus the proportion of ash.
R ,, annas per tons into wagons at the pit.
r ,, railway rate per ton (about ·228 annas).
M ,, number of miles transported from pit.

Then the cost of combustible matter delivered is equal to $\frac{1}{C}$(R—Mr).

Applying this to the following cases:—

	A.		B.
C Proportion of combustible..	0·85	..	6·60
r Rate per ton mile, annas ..	0·228	..	0·228
R Cost into wagons at the pit, annas	48	..	35
M Transport in miles	150	..	120
Actual cost of combustile delivered, annas	96·7	..	103·9

This calculation illustrates a case in which the rate into wagons of B sample was 13 annas per ton less than the A sample, and further, the transport of B was thirty miles less than that of A. But in spite of the apparent cheapness of the B sample, when the ash factor is allowed for, it is shown to be 7·2 annas per ton, delivered, dearer than the A sample. It is also interesting to note that the sample A could be delivered to a distance of 174 miles, namely, 54 miles further than the B sample, without exceeding at the point of delivery the cost, per ton of combustible, of the B sample.

From a practical stoker's point of view, Seebpore coal is eminently satisfactory. It burns freely without clinkering, and the fires are therefore easily kept clean. It is of a hard nature, and does not deteriorate by exposure to the atmosphere, as is the case with some Indian coals of otherwise good calorific power. It burns with a moderate degree of smoke with ordinary stoking, and with careful stoking can be made to burn with almost a smokeless chimney. During my visit to the colliery districts, I noted in the Seebpore seams that the coal was uniform in appearance and free from "traps." This uniformity of character is an important factor in the settlement of long contracts. As to the calorific power of this coal, the figures appended speak for themselves.

(Signed) FREDCK. GROVER,
A.M.Inst.C.E., M.I.Mech.E.

Results of a Test of Seebpore Coal.—Duration of test, 6 hrs. 9 mins.; number of boilers in use, 6; type and dimensions of boilers, 2-flued Lancashire, 8 ft. by 30 ft.; draught at base of chimney, 1 in. of water; draught in the main of flues, $\frac{3}{4}$ in.; total number of pounds of water evaporated, 180,000; total number of pounds of coal used, 22,570·5; actual evaporation per pound of coal, 7·97 lbs. water; evaporation from and at 212 deg. F. (equivalent), 9·15 lbs. water; maximum possible evaporation by calorimeter, 12·5 lbs. water; percentage of ash drawn from boilers, 16·7; percentage of ash from calorimeter, 11·5; original feed temperature, 100 deg. F.; feed temperature after heating by exhaust steam, 138 deg. F.; feed temperature leaving economisers, 240 deg. F.; coal fired per square foot of grate area, 19·1; total efficiency of the plant, 73 per cent.; pressure of steam in boilers, 125 lbs. per sq. inch; percentage of Co_2 in main flues, 8·4 per cent.

(Signed) FREDCK. GROVER,
A.M.Inst.C.E., M.I.Mech.E.

Notes on Books.

A HISTORY AND DESCRIPTION OF ENGLISH PORCELAIN. By William Burton, F.C.S. London: Cassell and Co.

Mr. Burton points out that there is room for a work on English porcelain, which should fill the gap between the elaborate monographs of single factories, and the valuable general sketch by Professor A. H. Church. This book is intended primarily for collectors and students, but the requirements of the general reader are not overlooked. It is fully illustrated with plates in colours, and in black and white, of specimens of English porcelain, and a full series of marks is given at the end. These are reproduced from photographs of the same size as the originals.

The author traces the history of the introduction of porcelain into Europe, before dealing with the special subject of his book. He writes:—"The first European porcelain of which we have absolute record, in the shape of identified pieces, was produced at Florence, under the patronage of the Medici, towards the end of the sixteenth century, about 1575-1585. The thirty or so known specimens of this production show that at that early date—well within the sixteenth century—a considerable degree of perfection had been attained in the production of an artificial porcelain. The extant pieces show, however, in the most indubitable manner, that the work never really passed beyond the experimental stage."

It was in France that the first real manufacture of a white and translucent pottery of great merit,

although different from Chinese porcelain, was established. This was in 1673, when Louis Porterat, "Le Sieur de St. Etienne," established a factory at Rouen. Very few pieces now extant can be traced to Rouen, but factories appear to have been opened in other parts of France, in emulation of Porterat's example. About the same date (1671), Dr. John Dwight, the eminent potter of Fulham, was granted a patent for his discovery of "the mistery of transparent earthenware, commonly known by the names of porcelain or china, and of stoneware, vulgarly called Cologne ware."

The word, "porcelain," was used at this time very loosely, and no example of anything that can properly be called porcelain, has been discovered, which could safely be attributed to Dwight. The third chapter contains a description of the various kinds of English porcelain in the eighteenth century, the results of which are summed up in the following useful analysis of the materials and methods of the three main species of porcelain:—

"*True porcelain* (Chinese, Dresden, Bristol, &c.). —Body or paste—petuntse and kaolin. Glaze—Petuntse, sometimes softened by addition of lime. Body and glaze fired at one operation, so that the glaze receives the fiercest heat given.

"*Glassy or fritted porcelain* (St. Cloud, Vieux Sèvres, Bow, and Chelsea).—Body or paste—largely glass or frit, with a small proportion of white clay. Glaze—a very fusible glass made from red lead, nitre, sand, &c."

The first operation was the preparation of the glass or frit. Some of the later English frits were not very glassy, and contained bone-ash. The body was fired to what is known as the biscuit condition, and the glaze was fired subsequently at a lower temperature.

"*English bone-porcelain* (practically all English factories of the nineteenth century). Body or paste—bone-ash, china stone, china clay. Glaze—china stone and china clay, with boracic acid, alkalies, and lead oxide. The body is fired just to what is known as the 'biscuit' condition, and the glaze is fired subsequently at a lower temperature."

Mr. Burton points out that the old terms, "hard paste" (meaning true porcelain), and "soft paste" (or artificial porcelain) are no longer useful and should no longer be used except in a special sense.

A chapter is devoted to "The Foreign Sources of English Design," which is illustrated by compared examples of foreign and English origin. The productions of Chelsea, Derby-Chelsea, Bow, Longton-hall, Derby, Worcester, Plymouth, Bristol, Caughley, and Coalport are described in separate chapters, while "the minor eighteenth century factories" consisting of Stourbridge, Musselburgh, Lowestoft, Liverpool, and Church Gresley are together treated in one. Mr. Burton allows nothing of value to have emanated from Lowestoft, and he only figures two objects, one an inkstand of the commonest character, and a teapot in the Victoria and Albert Museum, decorated with a representation, which although marked, "Allen, Lowestoft," is apparently Chinese porcelain. The handsome pieces elaborately ornamented and painted with European armorial bearings, although styled Lowestoft china, are now generally allowed to be Chinese porcelain painted in China, but Mr. Burton does not say much about the more ordinary cups and saucers, with festoons of roses, &c. Have the substance of these been proved to be of Oriental origin ?

The concluding chapters of the book deal with "Glassy Porcelains of the Nineteenth Century," "The Rise of the Staffordshire Factories," and "The Modern Developments of English Porcelain."

Essays on Rural Hygiene. By George Vivian Poore, M.D., F.R.C.P. Third edition. London: Longmans, Green and Co.

The first edition of this book was published in 1893, the second edition in 1894, and now Dr. Poore has brought the information up to date in a third edition. The main object of the author is to point out the mistakes that have been, and are being made in respect of sanitation, and to draw special attention to the great law of the power of the living earth to deal with organic refuse. After considering the questions of the concentration of population in cities, the shortcomings of modern sanitation, hygienic units, the living earth and the circulation of organic matter, the author deals in separate chapters on the home, air, and water, gives his personal experiences in a country town, in a London suburb, and as to a water supply, ending with the story of Brémontier and the reclamation of the sand-wastes of Gascony.

Blackie's Standard Shilling Dictionary. London: Blackie and Son.

This is a full dictionary of the English language in a convenient form, with eight appendixes, containing —(1) Terms and measures used in physics, engineering, &c.; (2) Words, phrases, &c.; (3) Abbreviations and contractions; (4) Forms of address; (5) Principal moneys of the world; (6) Weights and measures; (7) Signs and symbols; (8) Mechanical movements illustrated.

The Burlington Magazine for Connoisseurs, Nos. 1 to 6 (March to August, 1903).

A new monthly magazine, most elaborately illustrated, and containing a large number of articles on subjects connected with the Fine and Decorative Arts. Special attention is paid to early paintings, but a considerable range of artistic subjects will be found dealt with in the several numbers, such as manuscripts, lace, cards, Oriental carpets, porcelain, Bibliography. In connection with the magazine is also published the "Burlington Gazette," five numbers of which have been issued.

WALLPAPERS AND WALL COVERINGS, a Practical Handbook, by Arthur Seymour Jennings. London: Trade Papers Publishing Company.

This volume contains a fully illustrated account of the chief varieties of wall coverings, including papers, leather, lincrusta, woven materials, &c., and of the changes that have occurred in the popular taste. A chapter is devoted to the improvement in ceiling decorations, which are gradually coming into general use. The author holds that during the last twenty years a great advance has been made in the manufacture of wallpapers, and an equal advance in the artistic merit of the designs.

GUIDE TO THE SEARCH DEPARTMENT OF THE PATENT OFFICE LIBRARY. Second edition. London: 1903.

SUBJECT LIST OF WORKS ON GENERAL SCIENCE, PHYSICS, SOUND, MUSIC, LIGHT, MICROSCOPY, AND PHILOSOPHICAL INSTRUMENTS IN THE LIBRARY OF THE PATENT OFFICE. London: 1903.

These are two of the Patent Office Library Series, of which previous numbers have already been noticed. The first part of the guide deals with the specifications of various countries, and the second part with the subjects of patents arranged in alphabetical order. The subject list is No. 8 of the Bibliographical Series.

Obituary.

DR. CORFIELD.—On Wednesday, 26th of August, the death occurred at Marstrand, Sweden, of Professor William Henry Corfield, M.A., M.D., sanitary adviser to His Majesty's Office of Works, who became a member of the Society of Arts, in 1877, and delivered a course of Cantor Lectures on "Dwelling Houses: their Sanitary Constructions and Arrangements," 1879. He was born in 1843 and was educated at Cheltenham Grammar School, Magdalen College, Oxford, University College, London, and the medical schools in Paris and Lyons. Among the appointments which he held were those of Professor of Hygiene and Public Health in University College, London, honorary sanitary adviser to University College and Hospital, president of the Epidemiologieal Society of London, vice-president of the Sanitary Institute, and past-president of the Society of Medical Officers of Health. In 1868 he was appointed examiner for honours in the Natural Science School, Oxford, and he discovered the existence of lithodomous borings in the Aymestry limestone of the Silurian formation, and "thus removed to an earlier age than had been previously known the evidence of boring bivalves." He was the first professor of hygiene appointed in London, and started the first hygienic laboratory, which was at University College. For six years he was a member of and reporter for the British Association Committee on the treatment and utilisation of sewage, and he originated, in 1891, the meeting of the International Congress of Hygiene and Demography in London. The Royal Society of Public Medicine in Belgium awarded Professor Corfield a bronze medal for his work in connection with public health. He was the author of many works connected with public health, and among these are a "Résumé of the History of Hygiene," "Disease and Defective House Sanitation," which was translated into French, Hungarian, and Italian, "The Etiology of Typhoid Fever and its Prevention," and "Alleged Spontaneous Production of the Poison of Enteric Fever."

General Notes.

COINS AT THE ST. LOUIS EXHIBITION.—A rare collection of gold coins will be exhibited at the World's Fair by Ira D. Garman, of Philadelphia. The coins run from 50 dollar gold pieces to 25 cent pieces. The most valuable coin is a 50 dollar California gold piece, dated 1855. It is said to be worth 300 dollars. It is more than twice as large as a silver dollar. The oddest coins of the collection are the California octagons—very attractive pieces. The 25 cent pieces are very small, and thin enough to be bent between the fingers. Some are octagonal and some are round. An exceedingly rare coin of the collection is a papal coin. It is gold, and the size of a 10 dollar gold piece. Contained in the collection are many California gold coins which are very valuable, because they date back to the days of 1849, and are the output of private mints. During the days of 1849 in California, the primitive methods of transportation, the lawlessness, and the great danger of shipping bullion to the East and currency West, through wild, bandit regions, led to the establishment of private mints near the gold fields. Most of Mr. Garman's rare gold pieces came from these private mints.

FRENCH FRUIT IN ENGLAND.—A consular report, quoted by the Paris *Journal*, states that French fruit, valued at about 34,000,000 francs (£1,360,000), was exported to England last year. Out of this total green plums enter for 4,500,000 francs (£180,000), and Cévennes walnuts for 7,800,000 francs (£312,000), while the London market alone received pears to the amount of 5,000,000 frs. (£200,000), and cherries from the Rhône and environs of Paris to that of 4,000,000 (£160,000). Consignments were also made of currants to the value of 1,200,000 francs (£48,000), peaches and apricots to that of 600,000 francs (£24,000), fresh almonds 800,000 francs (£32,000), apples 1,800,000 francs (£72,000), and grapes 100,000 francs (£4,000).

Journal of the Society of Arts,

No. 2,651. Vol. LI.

FRIDAY, SEPTEMBER 11, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

"OWEN JONES" PRIZE.

This competition was instituted, in 1878, by the Council of the Society of Arts, as trustees of the sum of £400, presented to them by the Owen Jones Memorial Committee, being the balance of subscriptions to that fund, upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes are awarded on the results of the annual competition of the Board of Education, South Kensington.

Six prizes were offered for competition in the present year, each prize consisting of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The following is a list of the successful candidates :—

Blackburn, James W., School of Art, Huddersfield. Design for Woven Muslin.

Moss, Edwin, School of Art, Macclesfield. Design for Tile Panel.

Bailey, Tom H., School of Art, Macclesfield. Design for Furniture Silk.

Goodman, Abram, School of Art, Leeds. Design for Cretonne.

Collier, Louis C., School of Art, Nottingham. Design for Lace Curtain.

Brown, John, Kent-road Art Class, Glasgow. Design for Printed Velvet.

The next award will be made in 1904, when six prizes will be offered for competition.

CANTOR LECTURES ON HERTZIAN WAVE TELEGRAPHY.

Dr. J. A. Fleming's Cantor Lectures on "Hertzian Wave Telegraphy" have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C. A full list of the Cantor Lectures which have been published separately and are still on sale can be obtained on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

PAPER MANUFACTURE.

By Julius Hübner, F.C.S.

(Director of the Dyeing, Printing, and Paper-making Department, at the Municipal School of Technology, Manchester.)

Lecture I.—Delivered February 2nd, 1903.

History — Cellulose — Raw Materials — Boiling, Washing, Breaking and Bleaching.

From time immemorial man has employed the most varied methods for transmitting records of memorable events to coming generations, but probably the earliest evidence of the existence of such records is to be found in the inscriptions hewn into certain Persian rocks.

The ancients made extensive use of pyramids and obelisks, tablets of clay, marble, ivory and metal plates, the bark and leaves of trees, as objects upon which to inscribe their records, and also wooden boards, either plain or covered with a thin layer of beeswax.

Prior to the invention of paper, the Chinese painted letters upon pieces of silk, specially prepared with size; the woven mummy bandages, inscribed with hieroglyphics, afford proof of the use of cloth for writing purposes by the Egyptians. If we further consider, that skins of various animals, serpents, and fishes, the shoulder bones of sheep, the entrails of animals, &c., have been applied by the ingenuity of man in place of paper, we shall the better appreciate the immense importance of this modern invention.

Parchment and papyrus may be considered as the actual forerunners of our paper.

The former, the invention of which has been erroneously attributed to King Eumenes of Pergamos (263-241 B.C.), was beyond doubt

in use long before the time of Eumenes, and consists of suitably prepared skins of goats, sheep, pigs, and other animals. The manufacture and the consumption of parchment attained their greatest magnitude during the Middle Ages, and notwithstanding the fact that an excellent paper, equal in durability to the finest parchment, can now be procured at a much lower price, parchment is still used for certain documents. The term "paper" has

It is, perhaps, of some interest to point out here that the Emperor Tiberius and his successors put heavy taxes upon the manufacture of papyrus. These taxes, an ancient form of the paper tax, were repealed by Theodoric, King of the Goths, but were enforced again in various countries after his time, to be at last finally abolished in this country in 1861.

Paper consists of a thin leaf-like fabric pre-

Fig. 1.

Paper Duty Label, of date June 6, 1860.

its origin in the close outward resemblance of this material to the papyrus, which is manufactured from a water plant, named by the Greeks and Romans "papyros," by Homer and Herodotus "byblos," and by the Arabs "el berdy." The stem of this plant consists of a number of bast-like layers which are readily separable.

Pliny gives a detailed description of the manufacture of the papyrus, an industry which was already flourishing in 3500 B.C.

pared by reducing a mass of fibres to a state of minute division and depositing it from suspension in water by aid of a sieve. This method of manufacture was apparently introduced by the Chinese, and Tsailun, who was minister of the interior in 123 B.C., is generally credited with having made this important invention; he is said to have used as the principal raw materials the bamboo cane and the bast of the paper mulberry tree, *Brusonetia papyrifera*.

It may be of interest to give a short descrip-

tion of the methods employed by the Chinese in manufacturing paper from bamboo cane. The shoots of the plant are first treated with lime, then hammered in order to loosen the bark and afterwards bleached by exposure to the action of light and air. The boiling with lime is then repeated, a weaker solution being this time used. After this treatment the shoots are allowed to stand in heaps so that fermentation may proceed, and are then boiled with water in large vessels. The fibres are subsequently made up into bundles and treated with soda lye. The product thus obtained closely resembles the material known to us as "half stuff," and after being kept in steeping pits for some time is converted into pulp, by prolonged hammering or grinding in mortars; the sheets are made by dipping a mould made of bamboo and silk into the thin pulp.

The Chinese dry their paper in a very peculiar manner which consists in pressing the wet sheet on a smooth slab made of plaster of Paris, heated by means of a fire placed underneath. The water is thus rapidly extracted and the paper dried in a very short time; a number of the sheets are afterwards pressed together so as to smooth the surfaces.

Wall papers, 6 to 8 yards in length and 5 to 6 yards in width, were produced in China in ancient times. The handling of moulds of the large sizes needed, must naturally require remarkable skill on the part of the workmen.

The secret of making paper soon found its way from China to Korea and Japan, and the latter country especially has obtained a world-wide reputation for the manufacture of papers remarkable for their strength, durability, finish, and beautiful appearance.

From the East, the secret of making paper travelled to the West, thanks to the Arabs, who during the wars acquired this valuable knowledge. Damascus and Mecca were centres of a flourishing paper industry at an early date.

Numerous paper-mills were in existence in Egypt during the 10th century, and from the beginning of the 12th century, or even earlier than this time, paper-mills were in existence in Italy. Paper-making was introduced into Spain by the Moors, and its existence as an industry in France has been traced back as far as the end of the 12th century.

Animal size was found by Briquet in papers of Italian origin, made in 1271, and the invention of the water-marking of papers has also been attributed to the Italians.

Authentic proof has been given of the existence in Germany of a paper-mill erected by the brothers Holbein in Ravensburg, in the year 1336, and by Stromer in 1390 in Nuremberg.

From the 14th century onwards the industry developed and flourished in Germany, until it received a serious check in the 30 years war (1618-1648). Among the numerous paper-mills erected after the war, the one at Spechthausen, founded in 1781 by the famous French paper-maker, Jean Dubois, deserves mention. It is still in existence, and is well known for the manufacture of hand-made papers, and more especially of bank-note papers for the German Government.

Switzerland and Holland were well in the foreground among the paper-making countries during the 14th and 17th centuries. After the repeal of the edict of Nantes (1598), many of the best French paper-makers emigrated to Holland, Germany, and England, and shortly after the Dutch "hand-mades" commanded the markets of the world.

Koops has stated, that the existence of a paper-mill, situated in or near Stevenage, and belonging to John Tate, was referred to in a book printed by Caxton about the year 1490. The existence of this mill is also certified to by two entries in the household book of Henry VII., namely, one dated May 25th, 1498, "For a rewarde geven at the paper-mylne, 16sh. 8d."—and the other in 1499, "Geven in rewarde to Tate of the mylne, 6sh. 8d."

The German jeweller, John Spielmann, who was knighted for his services by Queen Elizabeth, erected a paper-mill in the year 1588 at Dartford. Spielmann, however, made only coarse papers, all the finer papers being imported from other countries, and principally from Holland and France. It is very probable that Shakespeare refers to Spielmann's mill in the following lines:—

> "Six hundret men are set to work by him,
> That else might starve or seek abroad their bread,
> Who now live well, and go full brave and trim,
> And who may boast, they are with paper fed."

Whatman studied the art of paper-making in Holland in 1770, and afterwards founded at Maidstone the mill which has still a world-wide reputation for its superior hand-made papers. Previous to the year 1700 rags were disintegrated and converted into paper pulp by a very tedious operation termed "stamping," but about that time special cylinder machines were invented, and actually used in Holland.

The invention of the "Hollander" or "rag engine" made it possible to secure an increased uniformity in the pulp, and resulted in a considerable saving of time and power; these improvements soon showed themselves in a rapid development of the paper industry. A complete revolution of the paper-making industry, and of many other manufactures and arts, was brought about by the wonderful invention of the paper-making machine by Louis Robert, a workman in the paper mill at Esonne, in France.

Robert applied for a French patent in 1797; this he ultimately received, together with a grant of £120 from the French Government, but a law case between Robert and his employer, Leger Didot, being decided in favour of the former, Robert transferred his patent to Didot.

In 1800 John Gamble secured an English patent for the paper machine. Robert's machine was only capable of producing long sheets of paper, and the honour of having built the first working paper machine on which a continous web of paper could be made was achieved by the English engineer, Bryan Donkin, in 1803.

The brothers Fourdrinier of London being confident that the invention, if properly worked out, would ultimately lead to success, induced Bryan Donkin to come to London and build another machine; this second machine was erected in 1804 at Two Waters Paper Mill in Hertfordshire.

After extensive trials, which cost the enormous sum of £60,000, the brothers Fourdrinier and John Gamble appealed to Parliament in the year 1807 for an extension of the term of their patent, pleading that they had not been able to interest paper-makers in the machine. The extension was granted by the House of Commons but was, however, shortly afterwards repealed by the House of Lords. A third machine had meanwhile been erected at St. Neots, but owing to this adverse decision the firm lost all their money and failed in 1808. This is without doubt one of the darkest periods in the history of paper-making since the Fourdriniers ended their days in the greatest poverty, notwithstanding the great services they had rendered to mankind by spending all they possessed in the perfection of an invention which ultimately found universal adoption. The student who wishes to study this part of the history more fully will find some excellent articles upon it in the *World's Paper Trade Review* of 1897 and 1898.

In attempting to cover the vast field of paper-making during the short time at my disposal, I shall only be able to give an outline of the many chemical processes and mechanical appliances employed.

Prior to entering upon a description of the numerous raw materials used in the manufacture of paper, it may be well to say a few words on cellulose, the chemical compound which forms the main constituent of plant tissues, and which in a more or less purified state forms the raw material used in such important industries as spinning, weaving, and paper-making.

Cellulose is a carbohydrate, having the empirical composition $C_6H_{10}O_5$. It is insoluble in water and in all ordinary solvents. Solutions of ammoniacal cupric oxide (Schweitzer's reagent) or zinc chloride dissolve cellulose readily; the former solvent is used in the manufacture of the well-known "Willesden" paper and canvas, and in the production of an "artificial silk," whilst by means of zinc chloride the so-called "vulcanised fibre" is produced.

Weak solutions of alkalis have no action upon cellulose, but on treating cellulose with strong solutions of caustic alkalis and subsequently washing, it becomes converted into hydrated cellulose, considerable shrinkage and structural changes of the fibres simultaneously taking place.

The action of strong solutions of caustic alkalis upon cellulose was first studied by Mercer, and has found very wide technical application during later years in the production of crimped cotton goods. If shrinking of the fibres during immersion in the caustic soda and the subsequent washing is prevented as much as possible, considerable lustre is produced; this process of treating cotton under tension with caustic soda, which is called "lustreing," has revolutionised the finishing of cotton goods.

Cross and Bevan have discovered that alkali cellulose, obtained by treating cellulose with strong solutions of caustic alkalis, is soluble in carbon disulphide. The compounds thus produced are cellulose sulpho-carbonates, and are readily soluble in water. From "viscose," as this product is termed, cellulose may be readily regenerated, a fact which is usefully applied in the sizing and printing of cotton fabrics, in the sizing of paper, in the manufacture of threads, &c. Weak mineral acids, under certain conditions, convert cellulose rapidly into hydrocellulose; the occurrence of

this change has to be carefully avoided by the paper maker. Strong sulphuric acid exerts a hydrating action on cellulose, which is technically applied in the manufacture of parchment paper, or "vegetable parchment." The nitric esters of cellulose, compounds produced by the action of nitric acid on cellulose, have found extensive technical application in the manufacture of collodion, explosives (gun cotton), artificial silk, celluloid, &c. Cellulose is not very readily attacked by oxidants; by the action of certain oxidising agents, however, the cellulose becomes converted into oxycellulose, and simultaneously the fibres completely disintegrate. If the formation of oxycellulose is allowed to take place during the bleaching of paper pulp, considerable loss to the paper-maker will result.

The so-called "compound celluloses" are far more widely distributed throughout the vegetable world than is cellulose itself; the latter occurs principally in the form of the cotton fibre; the principal representatives of this more complex class of substances are the oxycelluloses comprising lignified tissues, wood celluloses, esparto and straw celluloses and the jute fibre. These materials are of immense importance to the paper-maker.

It would be beyond the scope of these lectures to deal more fully with these compounds. It should, however, be mentioned that chemical reagents act more readily upon the lignocelluloses than upon cellulose; the manufacture of cellulose from wood and other lignocelluloses is based upon this fact.

Raw Materials.

Mineral substances, such as asbestos and the animal fibres — wool, silk, hair, &c., though employed in special cases as paper-making fibres, are not of sufficient importance to merit very special attention.

The principal raw materials used in the manufacture of paper are derived from the vegetable world. They may be conveniently divided into two classes—fibres from rags, ropes, &c., and fibres obtained from rag substitutes.

Under the title rags, we practically include all the materials which find their way to the paper-mill after having previously served for some other purposes (garments, ropes, string, jute bagging, &c.). Rag substitutes, on the other hand, are fibrous materials, which are employed directly as such, in the manufacture of paper (straw, esparto, wood, &c.).

Linen rags are, without doubt, the most valuable raw material for high-class writing and printing papers; no other fibre exhibits the fineness, the lack of elasticity, and the property of becoming beautifully white when bleached, which are characteristics of the flax fibre. The structure of the hemp fibre is very similar to that of flax, and hemp rags, netting and ropes, on account of the remarkable strength of the hemp fibre, are much in demand for the manufacture of papers, when strength and toughness are primary considerations. Although hemp stands next in importance to linen as a paper-making fibre, difficulties invariably present themselves in the bleaching of hemp rags. Cotton rags are also employed in the manufacture of the finest papers. The cotton fibre may be readily bleached, is very fine, and, generally speaking, is excellently suited for paper-making; it is, however, more elastic than the flax fibre, and for this reason it has to take a secondary position, so far as value is concerned. The use of wool and silk rags is limited to the manufacture of woollen bowl, coarse wrapping, and other papers, where a smooth surface is not essential.

Treatment of Rags.—The rags are first sorted according to the material of which they are composed, whether linen, hemp, cotton, jute, or Manila; and a further distinction is made between unbleached, bleached, and coloured rags. In many cases, it is necessary to sort the rags still further, taking into consideration whether they are in a more or less soiled condition, or whether they consist of unused clean cuttings. Usually the merchant offers rags which have already been sorted, to the paper-maker. It is, however, essential to the production of the finest paper, to sort the rags finally in the mill, in accordance with the special requirements. Various other preliminary operations succeed the sorting, and have to be performed with reference to the quality of the rags, and the kind of paper for which they are intended. The sorting and the cutting of rags is generally done by women, the rags being placed on tables, the top of which consists of a coarse wire gauze, with drawers below; on either side of the table, a scythe, 6-8 inches long, is fixed with its back towards the worker. The rags are carefully sorted, shaken, and cut into small pieces, hard substances being at the same time removed; sand and other impurities fall through the wire gauze into the drawers, which are emptied from time to time. The different qualities of rags are put into the respective baskets or

boxes, which stand near the tables, and the bottoms of which are lined with coarse wire gauze.

In well conducted mills, rags containing large amounts of mechanical impurities are dusted in special rag-dusters before being sent to the sorting and cutting-room. In some mills the cutting is done entirely by hand during the sorting, whilst in others special machines termed rag-cutters or choppers are employed for this purpose.

One type of rag-cutter consists of a large revolving drum, fitted with three knives; the rags are fed in along a table, the cutting being accomplished between a stationary knife on the table and the knives of the revolving drum. The essential part of another type, "Nuttall's rag-chopper," consists of two long and two short knives, the latter being placed at right angles to the former; an upward and downward movement is given to the knives, and the rags are cut or chopped into square pieces.

The cutting of rags by machine is cheaply and quickly performed, but cannot take the place of the more careful, though more expensive, cutting by hand, especially in the manufacture of the highest classes of papers, as the removal of unsuitable substances is most thoroughly effected by hand-cutting. The rags contain larger or smaller quantities of impurities of a purely mechanical character, the removal of which must be effected before the boiling operation. For separating such foreign substances the cut rags are in succession passed to machines called the "willow" and the "duster" respectively, which may be used either separately or in combination. In the "willow" the rags are beaten by means of revolving iron drums, furnished with iron teeth; from these they pass into the upper end of the "duster," a large revolving perforated cylinder, the axle of which is placed at a slight inclination. A number of strong iron teeth are fixed inside this cylinder, in which the rags are thoroughly shaken, the dust escaping through the perforated parts, whilst the cleansed rags are taken away from the lower part of the cylinder, and conveyed to the boiler-house. From an economical point of view, it is important to reduce the mechanical cleaning, *i.e.*, the dusting and willowing, to a minimum, the loss in valuable fibres inherent to these operations being in many instances very considerable.

The rags having undergone, so far, what may be termed the "mechanical" or "dry aning," are now ready for the "chemical" or "wet cleaning;" the rags are but rarely washed before the boiling. The object of the boiling is the removal of fatty and resinous matter, colours, starches, gums, &c., which accompany the fibre as natural impurities, or with which the fibres have been impregnated during the processes prior to the weaving and during the dyeing, printing, and finishing of the goods. The rags are boiled with alkalis, which results in the formation of soluble soaps if caustic soda or sodium carbonate is used, or of soaps insoluble in water if caustic lime is employed. The temperature and the pressure at which the boiling is conducted must be regulated according to the state of the rags, the quality of the paper to be made, and the nature of the impurities to be removed. In this operation, it has to be remembered that alkalis act on the fibres at high temperatures and pressures, and also that certain impurities, the removal of which is to be effected by boiling, are liable to become fixed on the fibres under these conditions. Caustic soda, on account of its solubility in water, has a very much stronger action than the sparingly soluble caustic lime, which exercises a more gentle action, any excess used being quite harmless; on the other hand, the insoluble lime soaps are more liable to become fixed on the fibres.

Prolonged boiling, at a low pressure and temperature with a weak liquor is for these reasons preferable to the application at high temperatures and pressures of a stronger lye. Sodium carbonate, caustic soda, and caustic lime are the alkalis employed in the boiling of rags. In some mills it is the practice to form caustic soda in the boiler itself, by adding both caustic lime and sodium carbonate. The action of sodium carbonate being a very gentle one, it is only used in the boiling of comparatively pure materials.

Stationary boilers are not much used for rag boiling, boilers of the spherical rotary type (Fig. 2) being considered the most effective; the invention of these latter is attributed to Piette. The capacity of rag boilers ranges from one to two tons, or even more, but it is not considered economical to employ boilers which hold less than one ton of rags at a time. The body of the boiler is made of strong riveted steel plates, steam entering through one of the hollow journals and lye being run in through the other.

The boiler is provided with a blow-off cock, a cock for running off the waste lye, a safety valve, a pressure gauge, a vacuum valve, and one or two manholes for filling and emptying.

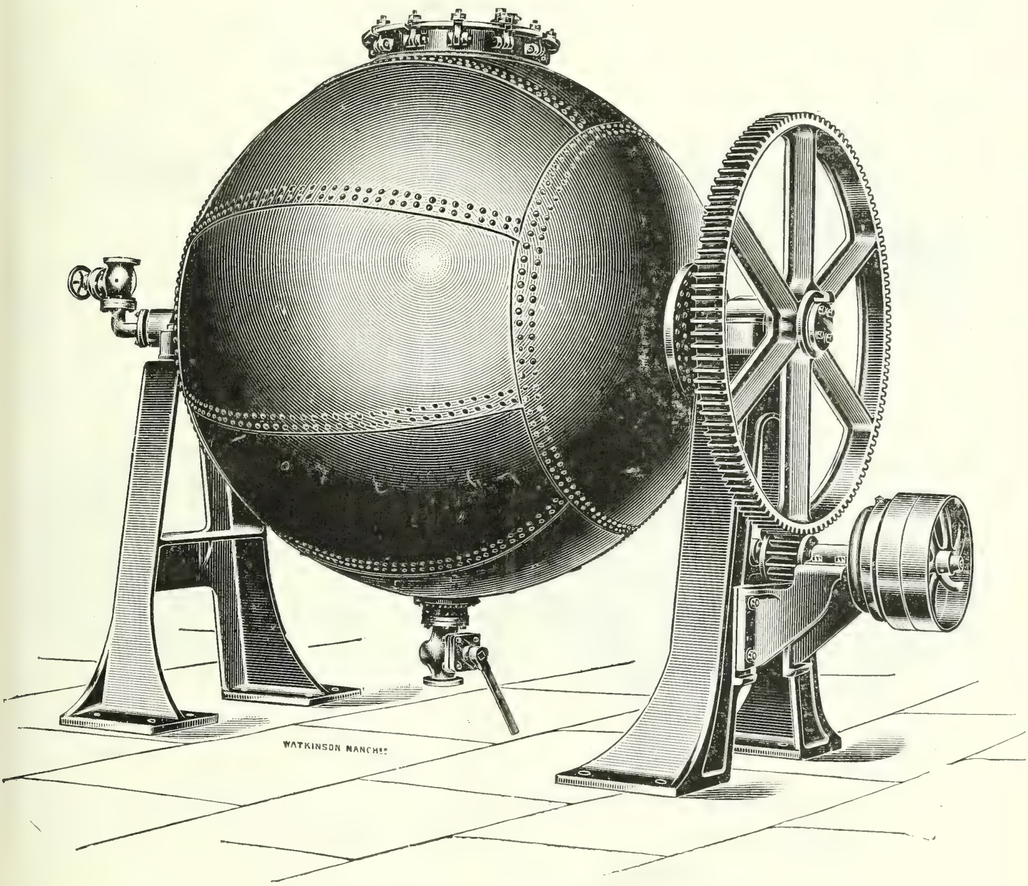
The advantages claimed for spherical revolving boilers as against the cylindrical type, are that they ensure a better admixture of the rags and a more thorough penetration of the lye, with quicker discharging after boiling, and less danger of explosion. Five to sixteen per cent. of lime, or three to ten per cent. of caustic soda upon the weight of the rags is conveniently used for boiling at a pressure of from 15 to 20 lbs. per square inch, and for from two to six hours.

It is the practice is some mills, after the boiling is completed and the steam shut off, to rotate the boiler for some time before introducing water for a preliminary rinsing.

After the washing, the rags are allowed to drain, and finally the boiler is emptied. The boiled rags are conveyed in boxes to the engine, known as the "washer" or "breaker" (Figs. 3 and 4), which is generally of the Holländer type; the breaker consists of a shallow rectangular vessel made of cast iron, or built in cement, with rounded ends, and divided in the centre by a partition called the "midfeather" (*a*). This, however, extends only as far as the two parallel sides of the trough. The floor in one of the two channels rises gradually, and carries about midway the so-called "bed-plate" (*b*), which is fitted with a set of knives. Heavy particles, contained as impurities in the pulp, are retained by means of a cross channel, called the "sand trap" (*c*), cut in the floor just in front of the bed-plate, and covered with grating.

Immediately above the bed-plate is placed the "breaker roll" (*d*), a heavy, rapidly revolving cylinder fitted with a number of parallel knives similar to those in the bed-plate; both ends of the roll may be simultaneously raised

FIG. 2.



BOILER OF THE SPHERICAL ROTARY TYPE.

or lowered. The rags, after passing between the knives in the roll and in the bed-plate, travel over the "back fall" (*e*), round the end of the midfeather into the opposite channel, to be brought once more under the action of the knives. The breaker is started with water alone, and the rags are introduced subsequently. During the operation of washing and breaking, a stream of fresh water is continuously run into the breaker, whilst the dirty water is removed by means of a "washer." Formerly, a fine wire gauze, stretched on a frame, was exclusively used for washing; it was

Fig. 3.

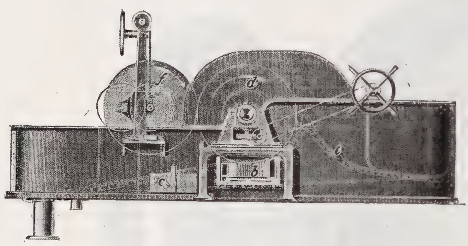
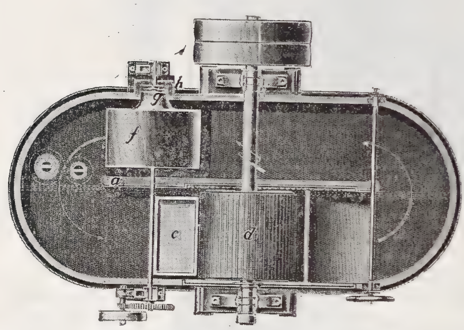


Fig. 4.



The "Washer" or "Breaker."

placed near the roll in such a position, that the stuff when thrown against it from the roll, fell back into the breaker, whilst the water escaped through its meshes.

A more modern, and at the same time more effective arrangement is the "drum washer" (*f*), usually placed in the opposite channel to the roll. It consists of a revolving cylinder, covered with a fine wire gauze, which is supported by a coarse netting or a perforated brass plate; the ends of the cylinder are usually made of brass, cast-iron, or mahogany. Curved paddles, fixed on a conical axis, divide the inside of the cylinder into compartments into which the water enters, and is lifted up; the water then flows towards the narrower end of the axis, and ultimately passes out through an opening (*g*), in the end of the drum. From here it is either conducted away through a pipe (*h*), placed outside the breaker, or through the hollow midfeather. The "syphon washer" is another type of drum-washer, similar in construction to the one described, but in which the water is conducted away by means of a syphon tube entering through the hollow journal. Breakers are constructed in various sizes, holding from 200 lbs. to one ton of stuff.

The washing and breaking ought to be conducted in the following manner:—After the breaker is filled with rags, sufficient space should be left between the knives of the roll and the knives in the bed-plate to allow of a fairly free passage, washing without cutting being in the first instance the object. After the washing has been completed, the roll is gradually lowered, so that the rags become acted upon by the knives. The disintegration should, however, result in a tearing and in no way a cutting of the fibres. For this reason it is obvious that both sets of knives should be perfectly blunt. The greatest care should be exercised in the breaking, as mistakes made at this early stage invariably have a detrimental influence on the ultimate result.

The fibrous mass, the product of the breaking and washing, is called "half stuff," and is now ready for the next operation, namely, that of bleaching. It is the practice in some mills to conduct the bleaching in the breaker, whilst in others special bleaching engines, called "potchers," are provided. The potcher resembles the breaker, with the exception that the knife roll is replaced by a simple paddle wheel and is usually built of cemented brick work, stone, or wood; iron is to be avoided, though in America, according to Hoffman, pulp for the finest note papers is bleached in breakers with iron knives.

Bleaching.

The bleaching action is essentially one of oxidation, by means of which colouring matters, which either accompany the fibres naturally, or have been used in the dyeing or printing of the fabrics, are converted into colourless compounds. The chemical agent usually employed in the bleaching of fibres is "bleaching powder," also known as "chloride of lime," first made about the year 1800, by Tennant, of Glasgow. Bleaching powder ($CaOCl_2$), when treated with water, forms calcium chloride ($CaCl_2$) and calcium hypochlorite, $Ca(OCl)_2$,

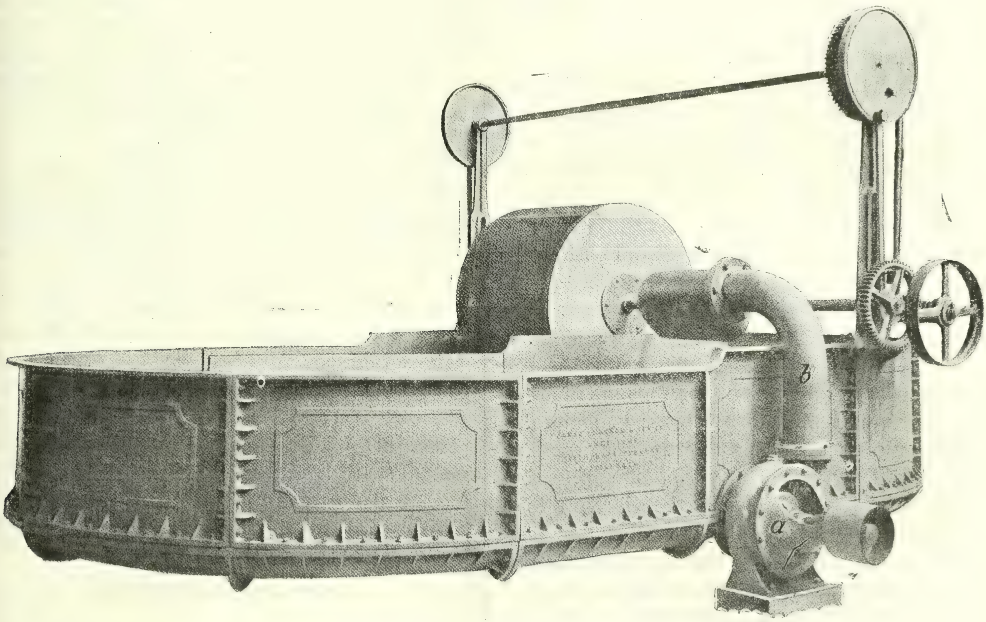
the bleaching properties being actually due to this latter active compound.

Bleaching powder, being an unstable compound, should be stored in cool, dry places; its decomposition into oxygen, chlorine, calcium chloride, and calcium chlorate, is accelerated by heat, light, air, and moisture.

The value of bleaching powder is expressed as the percentage of chlorine which is actually available for bleaching purposes, and should not be less than 35 to 37 per cent.; the powder ought to be pure white in colour. The bleaching action of bleaching powder is due to the formation of hypochlorous acid ($HClO$), which subsequently decomposes into hydrochloric acid and oxygen. The oxygen in the nascent state, like ozone, acts as a strong bleaching agent on all organic colouring matters. To avoid the contact of undissolved particles with the pulp, it is necessary to mix the powder carefully with water, and to allow the solution sufficient time for settling; in large mills, this is carried out in specially constructed tanks, provided with stirring arrangements. From these, the liquor is run into settling tanks, the clear solution being ultimately drawn off by means of a syphon; a stock solution of known strength should always be prepared.

The bleaching operation is conducted in the following manner:—The half stuff is run into the potcher with as little water as practicable, and the proper amount of bleaching solution added (3 to 10 lbs. of chloride of lime for 100 lbs. of paper). Frequently the pulp is bleached without the application of heat, but in some instances, more satisfactory results are obtained if the pulp is slightly heated. Great care must, however, be exercised in order to prevent overheating in parts next to the steam pipe, and, if possible, the pulp should be heated to the requisite temperature before the bleaching solution is run in. Sulphuric acid is added after the bleaching liquor has been in contact with the pulp for some time to accelerate the process of bleaching.

FIG. 5.



MODERN BLEACHING ENGINE.

To ensure a satisfactory result, it is very important to dilute the acid with water, and to add the diluted acid in 2-3 portions at short intervals; 5-10 parts of acid are used on the average for every hundred parts of chloride of lime.

Hydrochloric acid is less frequently employed than sulphuric acid, as its use involves the formation of a considerable amount of calcium chloride, which, on account of its hygroscopic character, necessitates a pro-

longed washing of the pulp. Carbon dioxide and alum have found but little technical application as substitutes for sulphuric acid. Dr. Lunge advocates the use of acetic acid for high-class papers.

Bleaching by chlorine gas, instead of by bleaching powder, has found extensive application to straw and other materials, but is not much in use for bleaching rags, except for very coarse qualities. For this purpose the pulp is freed from water as much as possible, and is placed on hurdles in large chambers, in which it is exposed to the action of the gas. As soon as the bleaching operation is completed the remaining gas is extracted by a fan and the pulp is removed. A subsequent bleaching in the potcher is, however, in many instances still necessary.

Generally speaking, this more troublesome method of bleaching will hardly recommend itself where bleaching powder can be obtained at a reasonable price. "Eau de Labaraque," or sodium hypochlorite, and "Eau de Javelle," or potassium hypochlorite, obtained by the decomposition of bleaching powder with soda, or with potassium carbonate respectively, as well as magnesium hypochlorite, have also been successfully used as bleaching agents.

Electrolytic bleaching processes. — The electrolysis of solutions of magnesium chloride and common salt has attracted considerable attention of late years, and was first practised technically by H. Hermite. He prepared magnesium hypochlorite by the electrolysis of magnesium chloride solution. Kellner uses cylinders in which the fibrous materials are exposed alternately to the action of the products of the electrolytic decomposition of salt, namely, to sodium or sodium hydrate formed at the one, and chlorine or hydrochloric acid formed at the other electrode.

Keller decomposes salt solutions in electrolysers, the electrodes of which are made of platinum-iridium, and Haas and Oettel have lately introduced an electrolyser with carbon electrodes, in which the hydrogen produced during electrolysis causes a continuous circulation of the salt solution. It is claimed that the bleaching efficiency of a solution of sodium hypochlorite, prepared electrolytically, is greater than that of a bleaching powder solution, containing an equal amount of available chlorine; at any rate this method of bleaching reduces the danger of the fibres being attacked to a minimum. I have just lately had opportunities of inspecting continental mills, where electrolytic bleaching is used on an extensive scale, with most excellent results, and in my mind there is no doubt that this method, which at the present is only in its infancy, will very rapidly develop in the future.

If the bleaching operation is carried too far, oxycellulose is produced, or chlorination of the fibre occurs; care must therefore be exercised in order to prevent a loss of valuable material. In the bleaching of dark-coloured materials, it is advisable to use weak liquors, and to prolong or to repeat their application. After treatment with the bleaching agent, the bleached and washed half-stuff is allowed to flow into steeping tanks; these are placed on a lower level than the breakers and are usually built of brickwork and cement, the bottom being covered with perforated tiles through which the liquors drain away. In some mills special hydraulic presses or hydro-extractors are used in place of the steeping tanks.

The loss in weight of material during the processes of cleaning and bleaching is quite considerable; Hoffmann states that 100 kilos. of rags yield, according to their quality, from 42 to 70 kilos. of bleached half-stuff.

A modern bleaching engine is shown in Fig. 5; this is patented by Cornett (Messrs. James Bertram and Son, Ltd.). The trough resembles that of an ordinary breaker with drum washer, but without the roll and bedplate. The Cornett pump, *a*, which is connected with an opening in the side of the trough, delivers the pulp through the pipe, *c*, over the backfall, thus ensuring rapid circulation of the pulp.

Miscellaneous.

*THE INFLUENCE OF BRAIN POWER ON HISTORY.**

Sir Norman Lockyer devoted the address with which he opened the proceedings of the British Association this year, to an urgent demand for the organisation of Science, and the improvement of Higher and University Education. The conclusion at which he arrived was that a Scientific National Council should be appointed, and that it should be able to dispose of large revenues, say an amount capitalised at £24,000,000, for the establishment of fresh Universities, the promotion of advanced education, and the endowment of Science generally.

* From the Presidential Address to the British Association for the Advancement of Science, Southport, 1903, by Sir Norman Lockyer, K.C.B., LL.D., F.R.S.

The following are the introductory passages of the address in which Sir Norman Lockyer led up to the detailed proposals for the great scheme he recommends:—

I think, although it is not generally recognised, that the century into which we have now well entered may be more momentous than any which has preceded it, and that the present history of the world is being so largely moulded by the influence of brain-power, which in these modern days has to do with natural as well as human forces and laws, that statesmen and politicians will have in the future to pay more regard to education and science as empire-builders and empire-guarders than they have paid in the past.

The 19th century will ever be known as the one in which the influences of science were first fully realised in civilised communities; the scientific progress was so gigantic that it seems rash to predict that any of its successors can be more important in the life of any nation.

Disraeli, in 1873, referring to the progress up to that year, spoke as follows: "How much has happened in these fifty years—a period more remarkable than any, I will venture to say, in the annals of mankind. I am not thinking of the rise and fall of Empires, the change of dynasties, the establishment of Governments. I am thinking of those revolutions of science which have had much more effect than any political causes, which have changed the position and prospects of mankind more than all the conquests and all the codes and all the legislators that ever lived."*

The progress of science, indeed, brings in many considerations which are momentous in relation to the life of any limited community—any one nation. One of these considerations to which attention is now being greatly drawn is that a relative decline in national wealth derived from industries must follow a relative neglect of scientific education.

It was the late Prince Consort who first emphasised this when he came here fresh from the University of Bonn. Hence the "Prince Consort's Committee," which led to the foundation of the College of Chemistry, and afterwards of the Science and Art Department. From that time to this the warnings of our men of science have become louder and more urgent in each succeeding year. But this is not all; the commercial output of one country in one century as compared with another is not alone in question; the acquirement of the scientific spirit and a knowledge and utilisation of the forces of Nature are very much further reaching in their effects on the progress and decline of nations than is generally imagined.

Britain, in the middle of the last century, was certainly the country which gained most by the advent of science, for she was then in full possession of those material gifts of Nature, coal and iron, the combined winning and utilisation of which, in the production of machinery and in other ways, soon made her the richest country in the world, the seat and throne of invention and manufacture, as Mr. Carnegie has called her. Being the great producers and exporters of all kinds of manufactured goods, we became eventually, with our iron ships, the great carriers, and hence the supremacy of our mercantile marine and our present command of the sea.

The most fundamental change wrought by the early applications of science was in relation to producing and carrying power. With the winning of mineral wealth and the production of machinery in other countries, and cheap and rapid transit between nations, our superiority as depending upon our first use of vast material resources was reduced. Science, which is above all things cosmopolitan—planetary, not national—internationalises such resources at once. In every market of the world

> "things of beauty, things of use,
> Which one fair planet can produce,
> Brought from under every star,"

were soon to be found.

Hence the first great effect of the general progress of science was relatively to diminish the initial supremacy of Britain due to the first use of *material* resources, which indeed was the real source of our national wealth and place among the nations.

The unfortunate thing was that, while the foundations of our superiority depending upon our *material resources* were being thus sapped by a cause *which was beyond our control*, our statesmen and our Universities were blind leaders of the blind, and our other asset, our mental resources, which was within our control, was culpably neglected.

So little did the bulk of our statesmen know of the part science was playing in the modern world and of the real basis of the nation's activities that they imagined political and fiscal problems to be the only matters of importance. Nor, indeed, are we very much better off to-day. In the important discussions recently raised by Mr. Chamberlain next to nothing has been said of the effect of the progress of science on prices. The whole course of the modern world is attributed to the presence or absence of taxes on certain commodities in certain countries. The fact that the great fall in the price of food-stuffs in England did not come till some thirty or forty years after the removal of the corn duty between 1847 and 1849 gives them no pause; for them new inventions, railways, and steamships are negligible quantities; the vast increase in the world's wealth, in Free Trade and Protected countries alike, comes merely, according to them, in response to some political shibboleth.

We now know, from what has occurred in other States, that if our Ministers had been more wise and our Universities more numerous and efficient, our mental resources would have been developed by improvements in educational method, by the introduction or science into schools, and, more important than all the rest, by the teaching of science by experiment, observation, and research, and not from books. It is because this was not done that we have fallen behind other nations in properly applying science to

* *Nature*, November 27, 1873, vol. ix., p. 71.

industry, so that our applications of science to industry are relatively less important than they were. But this is by no means all; we have lacked the strengthening of the national life produced by fostering the scientific spirit among all classes and along all lines of the nation's activity; many of the responsible authorities know little and care less about science; we have not learned that it is the duty of a State to organise its forces as carefully for peace as for war; that universities and other teaching centres are as important as battleships or big battalions; are, in fact, essential parts of a modern State's machinery, and, as such, to be equally aided and as efficiently organised to secure its future well-being.

Now the objects of the British Association as laid down by its founders seventy-two years ago are "To give a stronger impulse and a more systematic direction to scientific inquiry—to promote the intercourse of those who cultivate science in different parts of the British Empire with one another and with foreign philosophers—to obtain a more general attention to the objects of science and a removal of any disadvantages of a public kind which impede its progress."

In the main, my predecessors in this chair, to which you have done me the honour to call me, have dealt, and with great benefit to science, with the objects first named.

But at a critical time like the present I find it imperative to depart from the course so generally followed by my predecessors and to deal with the last object named, for unless by some means or other we "obtain a more general attention to the objects of science and a removal of any disadvantages of a public kind which impede its progress," we shall suffer in competition with other communities in which science is more generally utilised for the purposes of the national life.

The Struggle for Existence in Modern Communities

Some years ago, in discussing the relations of scientific instruction to our industries, Huxley pointed out that we were in presence of a new "struggle for existence," a struggle which, once commenced, must go on until only the fittest survives.

It is a struggle between organised species—nations—not between individuals or any class of individuals. It is, moreover, a struggle in which science and brains take the place of swords and sinews, on which depended the result of those conflicts which up to the present, have determined the history and fate of nations. The school, the university, the laboratory and the workshop are the battlefields of this new warfare.

But it is evident that if this, or anything like it, be true, our industries cannot be involved alone; the scientific spirit, brain-power, must not be limited to the workshop, if other nations utilise it in all branches of their administration and executive.

It is a question of an important change of front. It is a question of finding a new basis of stability for the Empire in face of new conditions. I am certain that those familiar with the present state of things will acknowledge that the Prince of Wales's call, "Wake up," applies quite as much to the members of the Government as it does to the leaders of industry.

What is wanted is a complete organisation of the resources of the nation, so as to enable it best to face all the new problems which the progress of science, combined with the ebb and flow of population and other factors in international competition, are ever bringing before us.

Correspondence.

ST. LOUIS EXHIBITION.

The American Society of Civil Engineers has appointed a committee to represent it at the Universal Exposition to be held at St. Louis, in 1904, to commemorate the Louisiana Purchase.

It is the purpose of the committee to collect and present an exhibit of plans, photographs, models, and descriptions of American engineering works, principally work designed by members of the American Society, which it is believed will be of great interest both to laymen and engineers. It is intended also to make the headquarters of the Society, which will be in the Liberal Arts Building, a centre of information as to other exhibits in the Exposition which may be of engineering interest. There will also be a register, which will help one to find and meet his friends, and it is hoped that the headquarters may serve as a rallying point and rendezvous for all visiting engineers.

The members of the Society of Arts are cordially invited to avail themselves of the conveniences to be provided by our Society during their visit to St. Louis and the Exposition, and it is hoped that a large proportion of them will be able to do so.

H. J. PFEIFER,
Secretary.

St. Louis, Mo., U.S.A.
August 24, 1903.

General Notes.

WATER-JETS AND ELECTRICITY.—The danger from electricity for the fireman in directing a stream of water upon an object carrying electric current, was the subject of an article in a recent issue of *Energie*, of Berlin, recording the results of a number of tests. A man wearing wet shoes, and standing on a wet plank flooring, threw a jet of water on an electrified plate. At 500 volts and an aperture of 0·47 in. in the nozzle, he felt the current at a distance of $2\frac{3}{4}$ in., and with an aperture of about 2 in. could not get nearer than about $3\frac{1}{4}$ ft. Under the same conditions, but with alternating current, he could not stay within 8 ft., and at 3,600 volts he had to remain at a distance of 26 ft.—*Engineer*.

Journal of the Society of Arts,

No. 2,652. Vol. LI.

FRIDAY, SEPTEMBER 18, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS, 1904.

These Examinations will commence on March 21st, 1904.

The Programme for 1904 is now ready, and can be had, price 3d., on application to the Secretary, Sir Henry Trueman Wood, Society of Arts, Adelphi, London, W.C. It contains full details of the examinations, together with the questions for 1903, reports by the Examiners, and a list of the centres where examinations are held.

The questions for the years 1896 to 1902 inclusive (with the exception of 1899), can also be obtained (price 3d. each year) on application as above.

PRIZES FOR DESIGNS FOR FURNITURE.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in Prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers, and Hangings, Damasks, Chintzes, &c., regulated by the principles laid down by Owen Jones."

The prizes will be awarded on the results of the Annual Competition of the Board of Education, South Kensington. Competing designs must be marked "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1904, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

SECTIONAL COMMITTEE.

The following is the list of the Indian Section Committee as appointed by the Council:—

INDIAN SECTION COMMITTEE.

Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S. (Chairman of the Council).
Sir William Lee-Warner, K.C.S.I. (Chairman of the Committee).
Sir Frank Forbes Adam, C.I.E.
Lionel R. Ashburner, C.S.I.
Jervoise Athelstane Baines, C.S.I.
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Sir Alexander R. Binnie.
Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D.
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Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.
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Everard R. Calthrop.
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Thomas William Holderness, C.S.I.
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Sir James Broadwood Lyall, G.C.I.E., K.C.S.I.
Sir James Lyle Mackay, G.C.M.G., K.C.I.E.
J. M. Maclean.
Edmund Neel, C.I.E.
John David Rees, C.I.E.
General J. Michael, C.S.I.
Sir Patrick Playfair, C.I.E.
Field-Marshal Earl Roberts, V.C., K.P., G.C.B., G.C.S.I., G.C.I.E.
Sir George Scott Robertson, K.C.S.I.
Alexander Rogers.
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Sir John Scott, K.C.M.G., M.A., D.C.L.
W. S. Seton-Karr.
Sir Charles Cecil Stevens, K.C.S.I.
Colonel Sir Richard Carnac Temple, Bart., C.I.E.
Carmichael Thomas.
Thomas H. Thornton, C.S.I.
Sir Charles A. Turner, K.C.I.E.
Sir Raymond West, K.C.I.E., M.A., LL.D.
Arthur N. Wollaston, C.I.E.
W. Martin Wood.
S. Digby (Secretary).

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

PAPER MANUFACTURE.

By Julius Hübner, F.C.S.

(Director of the Dyeing, Printing, and Paper-making Department, at the Municipal School of Technology, Manchester.)

Lecture II.—Delivered February 9th, 1903.

Esparto—Straw—Soda recovery—Manila hemp—Jute and other raw materials—Mechanical wood pulp—Wood cellulose.

Rag Substitutes.

Although Seba, Reaumur, Gleditsch, and others, suggested the use of numerous kinds of material in place of rags, and although the Chinese and the Japanese have made paper for many centuries from fibres obtained directly from various plants, rags were used nearly exclusively in Europe, as raw-materials for paper-making, until the middle of the 19th century.

Dr. Jacob Christian Schäffer fully recognised the necessity and the value of finding raw materials, other than rags, suitable for paper-making, in his book published in 1756. Several beautifully preserved copies of different editions of this work are contained in the library of the British Museum. This book contains specimens of paper made, as its author states, from sawdust, moss, willow, aspen, pine wood, hops, hemp, rye straw, thistle stalks, peat, wasps-nests, and many other materials. Professor Herzberg, of Charlottenburg, who examined some of these papers found, however, that the descriptions given are mostly incorrect; in many instances the papers contain only small quantities of these materials, whilst rags have been used to a very large extent. There is, however, no reason to doubt, that Schäffer acted in good faith; probably the paper-makers to whom he entrusted the manufacture found it difficult to produce the papers in accordance with his description, and used rags without his knowledge. At some time previous to 1801, Matthias Koops experimented on the use of straw, wood, and old paper as paper-making raw-materials, and his book is printed partly on paper made from straw, wood, and from old paper remade. Koops may therefore be considered as the first who employed these rag substitutes in a practical manner.

Among the numerous rag substitutes which have found extensive technical application, the following may be described:—

Esparto Grass.—The esparto fibre, obtained from the grasses *stipa tenacissima* and *machrocloa tenacissima*, both natives of Spain, Portugal, and Northern Africa, is, in its pure state as esparto cellulose, a fine, smooth, rather elastic fibre which may be readily bleached. It has found a very wide application, especially in this country, in the manufacture of high-class printing and other papers, and is either used alone or in conjunction with wood cellulose, and other fibres. This valuable raw-material was successfully introduced in England in 1856 by the well-known paper-maker, Thomas Routledge.

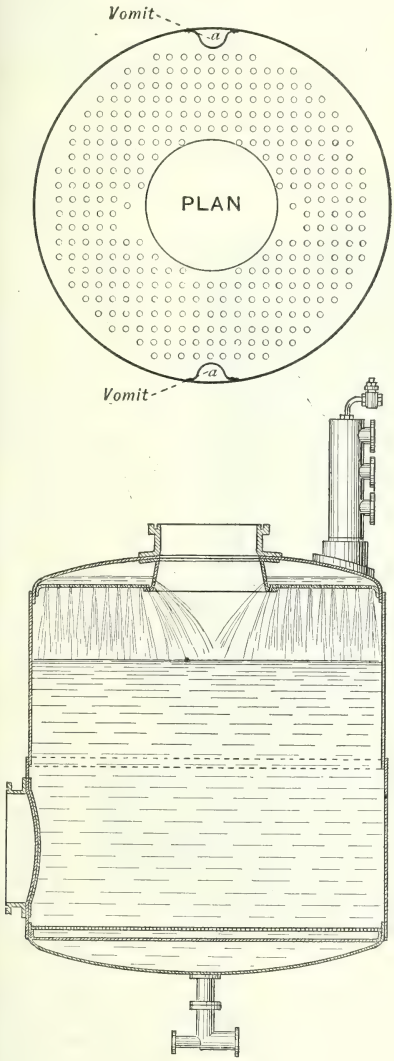
Treatment of Esparto.—On opening the bales in the mill, the grass is spread out on tables, and impurities, such as the roots and ends, are removed; this operation is generally performed by women, and is called the "picking;" special machines are, however, provided for the dusting in mills in which large quantities of esparto are used.

According to Cross and Bevan, the percentage of cellulose in various kinds of esparto is from 45·6 to 58·0 per cent.; these numbers show clearly that a considerable portion of the material consists of non-cellulose constituents. A large amount of caustic soda is therefore required in the boiling. Lime is not employed on account of its forming insoluble compounds with the non-cellulose portion.

It is usually the practice to boil esparto grass in stationary boilers constructed on the "vomiting" principle. A simple form of this boiler consists of a vertical cylinder provided with a central pipe through which the liquor is forced upwards by means of steam. On reaching the top the liquor is distributed over the grass, through which it then passes in its downward course. A continuous circulation is thus ensured. On account of the bulky nature of the grass, in filling the boiler, grass and caustic soda have to be introduced alternately; the time of boiling, the pressure, and the quantity of soda required, vary according to the kind of grass. Two modern types of esparto boilers are those invented by Roeckner and Sinclair respectively; the most important respect in which they both differ from the ordinary vomiting type is, that nearly the whole of the space in these boilers is available for boiling purposes. In the Sinclair boiler (shown in Figs. 6 and 7), the

quor is conducted through pipes (a), which re rivetted to the sides of the boiler. After he boiling is completed the grass is roughly vashed in the boiler itself, hot, and subsequently cold, water being run in after discharging the soda lye. The boiled grass is ext conveyed to the breaker, in which it is

FIGS. 6 AND 7.



urther washed and converted into "halfstuff;" the knives in the roll, as well as in the ed-plate, should be blunt. The esparto halftuff is next usually conducted directly to the leaching engine. Ten to 15 lbs. of bleaching owder for 1 cwt. of grass, may be taken as he average quantity needed for bleaching a vell-boiled pulp. For the purpose of freeing the stuff from the excess of bleaching liquor, the "press pâte" system has lately come more and more into use, in place of the older method of running the pulp into draining chests. In the press pâte system the pulp is passed over sand tables and through strainers, and is ultimately conducted to an arrangement similar in construction to the wet end of a paper machine; a large portion of the impurities contained in the pulp are eliminated by means of this treatment. A considerable quantity of the cellular tissue and of the short fibres are carried away by the wash water during the washing of esparto, and thus become lost to the paper-maker.

STRAW.

Straw cellulose may be obtained from various kinds of straw, such as those of wheat, oat, rye, barley, and maize. Although straw in many respects very closely resembles esparto, it yields in general less pulp than esparto. Straw cellulose is frequently used in the manufacture of high-class writing and printing papers, either in place of, or together with, esparto and other fibres. Partially boiled, unbleached straw pulp is very extensively used in the manufacture of the so-called straw papers and straw boards.

In 1860, Piette made very exhaustive trials with numerous kinds of straw, such as those from pea, lentil, bean, Indian corn, rye, oat, wheat, and barley; and a great number of samples of paper thus made by him, are contained in his book, "Die Fabrikation des Papieres," published in 1861. The straws, now mostly used as paper-making materials are those from wheat, oat, and rye.

Although straw contains as much cellulose as esparto (48 to 52 per cent.), the lower yield of cellulose invariably obtained from it is explained by the fact that it contains very considerable amounts of cellular tissues, which are lost during the various operations.

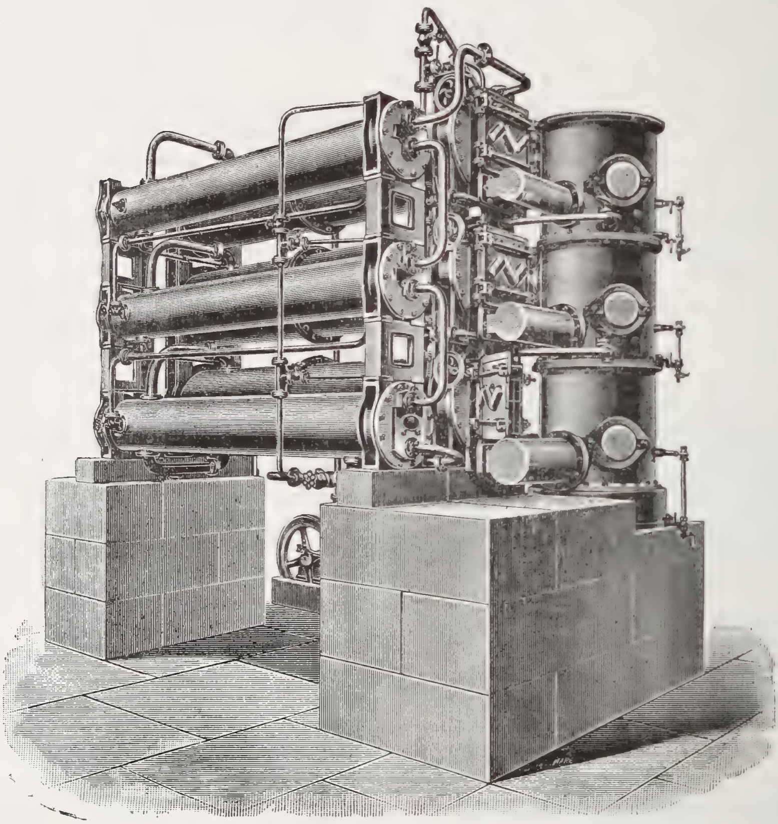
Owing to its bulky nature, the first operation which the straw has to undergo, is that of cutting or chopping; this is followed by dusting, in which part of the heavier knots and other impurities are separated. The boiling is usually conducted in cylindrical, or revolving spherical boilers, caustic soda being used as the boiling agent; the straw becomes, to a very large extent, disintegrated by the boiling. The boilers should revolve very slowly, as, if the disintegration is carried too far, a very considerable loss of fibre is incurred.

In washing straw pulp, the finest wire gauze

should be used as covering for the drum washer, so as to prevent, as far as possible, the carrying away of the minute fibres with the waste water. Lespermont has constructed a special type of washer for straw pulp, the action of which is based upon the counter current principle. A series of conical drums covered with wire gauze, through which the pulp passes in succession, is arranged in such a way that, after leaving one drum, the pulp becomes mixed with water which has already passed through the covering gauze of the preceding one; the pulp is then conducted by means of a lifter to the next drum, and so on, until it has passed through the whole series. The formation of knots, and the costliness of the plant, have no doubt prevented the more general adoption of this kind of washer. The washing of straw may be very economically conducted, and the loss of fibres reduced to a minimum by the use of a system of tanks similar to the lixiviating tanks used in alkali works.

It is the practice in some mills to pass the pulp between a pair of rapidly-revolving granite mill-stones, so as to cause uniform disintegration of the knots and other hard portions which have not been sufficiently acted upon during the boiling. Breaking, in the proper sense of the word, is not required in the case of straw pulp, all that is necessary being a complete separation and brushing of the fibres; the bleaching is generally conducted in potchers specially provided for this purpose. A straw cellulose of great purity is obtained by exposing the partially dried pulp to the action of chlorine gas in leaden chambers; after this treatment the pulp is readily disintegrated and bleached. Dahl's sulphate process is also used in the manufacture of cellulose from straw.

Fig. 8.



Soda Recovery.

The large quantities of soda liquors resulting from the boiling of straw and esparto were formerly simply discharged into the rivers. This practice is very costly and

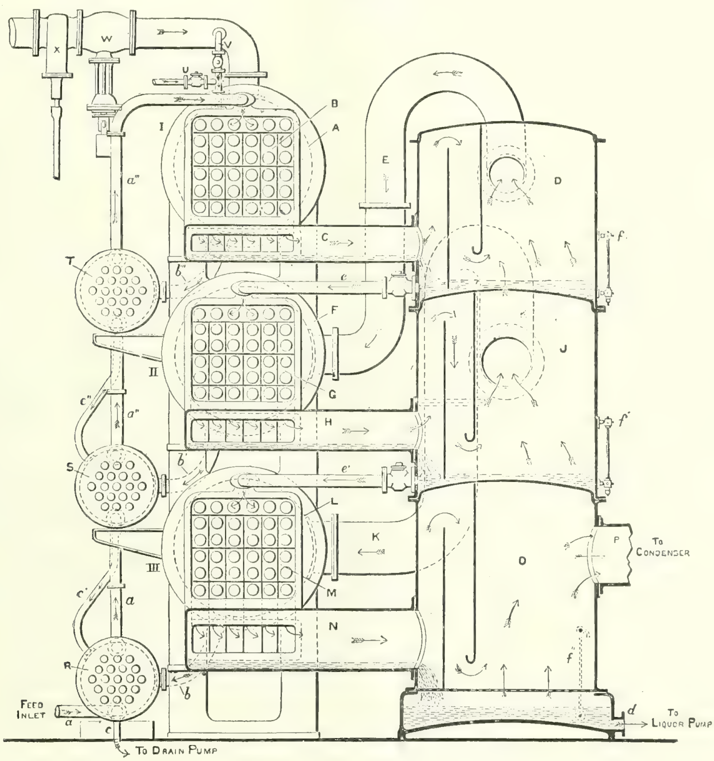
also very injurious in its effects, and had, thanks to the Rivers Pollution Act, to be abandoned. The disposal of these as well as of other mill effluents, has received widespread attention. It is interesting to quote here a remark made by Mr. Arnot in his excellent Cantor Lectures on the manufacture of paper, delivered in 1878, in which he clearly expresses his opinion upon this important question. His remarks refer to some Scotch mills :—

"I am far from being in favour of harsh measures, and quite realise the importance of fostering rather than oppressing our manufacturers; but where it can be shown, that a public good can be effected, not only without the loss to the manufacturer, but at a positive gain, there is little reason why it should not be done. The paper-makers on the Esk, near Edinburgh, who were the first driven to evaporate their liquors, &c."

The only effective way of disposing of the boiling liquors consists in the recovery of the soda.

The soda recovery may be divided into two parts, the first, which comprises the evaporation of the liquor to dryness and the ignition of the residue, and the second, in which the sodium carbonate is converted into caustic soda, termed the "causticising." During the first process the soda liquor highly charged with dissolved organic matter is converted mainly into sodium carbonate. The evaporation and the ignition of the residue are carried out in plant of varying construction. One very simple arrangement consists of a furnace from which the fire gases are conducted over the highly concentrated liquors; further along, over the flue, is placed a large tank to which the more dilute liquor from the boilers is conducted and in which it is heated by the gases before they find their way into the chimney. Porion has designed a plant in which the heat is more economically used; in this, the gases, after having been used for incineration, pass through a large chamber into which the boiling liquors are conducted direct from the boilers. A large evaporating surface is obtained by converting the liquor into a fine spray by means of rapidly revolving fans placed at a small distance from the floor of the chamber.

Fig. 9.



In Ibotson's and Roeckner's apparatus the

partly evaporated liquor flows on to a series of shallow trays over which the hot gas coming from the furnace is conducted.

Chapman's evaporator consists of a series of three vacuum pans in which the evaporation is conducted under low pressure and at correspondingly low temperatures; the liquor after leaving the third pan becomes gelatinous.

The economical working of any form of evaporator depends, in the first instance, upon the best possible utilisation of the heat in the evaporation of the liquor. The modern evaporators, of which the Yaryan is a typical representative, are based upon the principle of "multiple effect." The Yaryan evaporating plant (Figs. 8 and 9)* consists of a system of three horizontal tubular boilers. The liquor passing in at the one end of the first boiler traverses its tubes and is delivered into a chamber or separator provided at the opposite end.

During this passage the liquor is heated by means of steam with which the tubes are jacketted. From the first chamber, the liquor is conducted through the second system of tubes, whilst the vapour liberated in the first chamber is used to heat the liquor during its passage through the second system; the pressure in the tubes is reduced by means of a vacuum pump. Thus it will be clear, that the latent heat of the vapour given off in the first chamber is used to heat the liquor in the second system, and so on. The evaporation in this type of evaporator is, therefore, a continuous process in which weak liquor is fed in, whilst a highly concentrated lye, ready for incineration, is being discharged.

In Fig. 9, which represents a sectional view of a Yaryan standard triple effect evaporating apparatus with patent heaters, A, represents the shell or heating chamber of the first effect, I, heated with direct steam; B, the ends of the evaporating tubes through which the liquor travels; C, branch conducting to first separator, D; E, vapour pipe to second shell or heating chamber; the second effect, II, is heated with vapour from effect I; F, shell like A; G, the corresponding evaporating tubes; H, branch to second separator, J; K, vapour pipe to shell, L, of the third effect, III, and so on. P is the vapour pipe to the condenser; R is the first multiple effect heater, heated partly by drain water from the previous heater, S, and from the shell L; S is the second multiple effect heater; and T, the third preliminary heater, heated partly by drain water from the first shell and partly by steam from the latter.

*I am indebted to the Mirrlees Watson Co. for drawings and particulars of the Yaryan evaporating plant.

In many modern works the incinerating furnaces are becoming more and more replaced by the Warren type of revolving furnace as used in alkali works.

The process of incineration is followed by that of causticising. The soda, as it leaves the furnace is generally dissolved in vessels provided with mechanical stirring arrangements; the application of heat is essential on account of the presence of silicate of soda. Although it is the practice in some works to causticise in the vessel in which the soda has been dissolved, the proper way is to conduct this operation in a separate vessel.

After the lixiviation the soda liquor is heated with lime, and well agitated by means of stirrers or by the injection of air. The caustic liquor may be drawn off through a syphon after the insoluble lime mud has been allowed to settle. It is then brought to the degree of concentration required and re-used for the boiling of a fresh quantity of raw material.

Another causticising process, in which ferric oxide is used, is that of Brunner Mond's. At high temperatures ferric oxide expels the carbon dioxide and combines loosely with the soda; the compound thus formed readily decomposes on addition of water into insoluble ferric oxide and caustic soda.

Manila Hemp.

The Manila hemp is derived from a tree (*Musa Troglodytarum textoria*) growing abundantly wild in the Philippine islands, and is chiefly used for the manufacture of ropes. On account of the extraordinary strength of the fibres this forms a very valuable paper-making raw material, especially for the manufacture of papers in which strength is of primary importance whilst the colour is a secondary consideration. Manila hemp is, however, often used in conjunction with cotton and flax fibres.

Jute.

The jute plant is a native of the East Indies. The so-called jute "butts" and the various qualities of cloth made from jute ultimately find their way into the paper mills. On account of the introduction of other fibrous materials such as brown mechanical wood pulp, wood cellulose, &c., for the manufacture of wrapping papers, the demand for jute has diminished considerably, although it was for-

merly very extensively employed as a substitute for Manila.

Adansonia.

Adansonia, the bast of the monkey bread tree (*Adansonia digitata L.*) of West Africa, is used for manifold purposes by the natives, and forms the raw material for a paper-making fibre remarkable for its strength and toughness; Adansonia papers show a resistance to tearing not unlike that of the Japanese papers. It is much to be regretted that this valuable material is only obtainable in very limited quantities.

Flax Waste.

The waste from flax is used in some mills as a cheap substitute for hemp and Manila hemp in the manufacture of brown wrapping papers. Manila hemp, jute, adansonia, and flax waste, are boiled either with lime or with caustic soda as described under straw and esparto, according to the purpose for which they are intended. The yield obtained with lime is better than that given by soda, but the colour of the pulp is inferior. The bleaching of these fibres is always attended with difficulties and a repetition of the treatment with bleaching liquor is often found necessary to obtain a satisfactory white colour.

Peat.

As early as 1765 Schäffer tried to use peat for paper-making and samples of papers made partly from peat are contained in Louis Piette's book, "Die Fabrikation des Papieres," published in 1861. Since that time attempts have been made to use peat in the manufacture of paper, but without satisfactory results. During the last few years, however, more promising results have been obtained owing to a special method of disintegration by means of which the fibres are separated without their strength being diminished.

Sorghum and Sugar-cane.

From both of the above materials useful paper-making fibres may be prepared, and they are used in places where easily obtainable.

Bamboo.

Thomas Routledge, during and after 1870, made very extensive experiments with the object of introducing this excellent paper-making fibre, so extensively used by the Chinese, into this country; he did not, however, succeed in obtaining satisfactorily practical results.

Numerous other plant tissues have from time to time been suggested, used and disused for paper-making, and some are still in use for special purposes. Various kinds of reeds, the China grass, sun hemp, hey, and potato husks may be mentioned in this connection.

Broke.

"Broke" paper is of considerably more importance than some of the foregoing as a paper-making material; it includes paper which has been used and printed upon and which finally finds its way back into the mill, and also the spoilt paper, which has always to be rejected when a paper machine is started or when the paper during its journey on the machine accidentally breaks. The "broke" is divided into various qualities, according to the composition and state of purity, and according to whether the paper is white or printed upon. The treatment has, therefore, to be chosen according to the quality. In order to free the paper from greasy matter and printing ink, it is first of all boiled—usually with soda lye—in open or revolving boilers. Papers which have been printed upon were previously worked up into inferior qualities on account of the impossibility of effectively removing the printing ink, but Knopf has patented a process by means of which the ink is successfully removed by treating the paper with soap solutions. The broke paper produced during manufacture requires little or no treatment if it is still in a moist condition, and in many cases it may be thrown back into the beater; if dried, however, a slight boiling may be found necessary for the purpose of removing the size. The fibres in "broke," being already in a sufficiently disintegrated condition, require no further beating, and passing through one of the various types of "stuff squeezers," such as Wurster-Voith's (Figs. 10 and 11) or Simonet's, or grinding in an "edge runner" (Kollergang) is generally found sufficient treatment.

Mechanical Wood Pulp.

Although Schäffer and others before him had tried to employ wood as a paper-making raw material, Matthias Koops is the first who used wood in a practical manner. In two copies of his book in my possession, now over 100 years old, which are both partly printed on paper made from wood, the leaves are in a state of perfect preservation. All that may be justly urged against the use of wood as a paper-

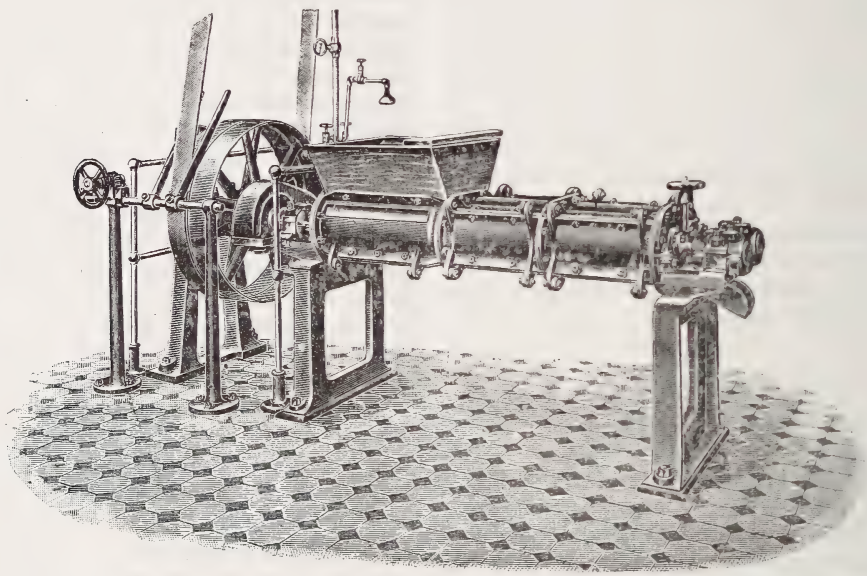
making raw material is, without doubt, by far outweighed by the vast benefit which we have derived from its introduction. F. G. Keller, a weaver, born in Haynichen, in Saxony, in the year 1816, is the inventor of mechanical wood pulp; in 1840 he commenced a series of successful experiments on this subject. Keller entered into an agreement with Voelter, but by 1846 had practically lost his share in the invention. The further working out and the introduction of the process after this date are due to Voelter, and Keller received only a few pounds as his share. In 1892 he appealed to the paper-makers for help, and it is of interest to state that—according to Hofmann, who gives a full account of Keller's life in his standard work on paper-making—a collection made in various countries realised the sum of about £1,000, to which the paper-makers of this country contributed about £22.

The pulp obtained by the disintegration of wood by mechanical means only, is called "mechanical wood pulp." The various species of pine-wood—*Pinus picea*, *Pinus abies*, *Pinus Sylvestris*—form the principal raw materials for this product. The pulp obtained from *Pinus picea* possesses the best paper-making qualities. Poplar, aspen, birch, linden, beech, maple, and other woods are also used, though on a less extensive scale. Mechanical wood pulp constitutes the principal raw material in the manufacture of news and cheap papers generally; it possesses hardly any felting properties, and admixture with other fibres, such as wood cellulose, is therefore absolutely necessary, to impart to the paper the necessary strength.

Manufacture of Mechanical Wood Pulp.

Carefully-selected wood is freed from the bark, from knots and from all such portions as might have a detrimental influence on the quality of the pulp, by means of special boring and other machines. The next operation consists in the grinding of the wood, and the apparatus employed varies in construction in the different mills.

Fig. 10.



A large cylindrical sandstone, revolving either horizontally or vertically, forms the essential part of the grinding arrangement; the cylindrical surface of the stone is roughened and grooved so as to present a large grinding surface. The wood blocks are steadily pressed against the surface of the stone by means of screws or, in more modern mills, by means of hydraulic presses. A continuous stream of water is directed between the blocks, thus preventing overheating of the wood, the water serving at the same time to carry away the ground wood.

A passage through a sorter, which consists of a series of frames (the upper one being

covered with a very coarse wire gauze, whilst in the lower ones the size of the mesh is gradually diminished), divides the pulp into various grades. The coarsest pulp is passed through an apparatus called the "refiner," which resembles a pair of millstones such as are used in a flour mill. Although uniformity of pulp is obtained by this treatment the disintegration, if carried too far, results in complete destruction of the fibrous nature of the pulp.

The final operation is the conversion of the pulp into boards, and this is accomplished on a "board machine."

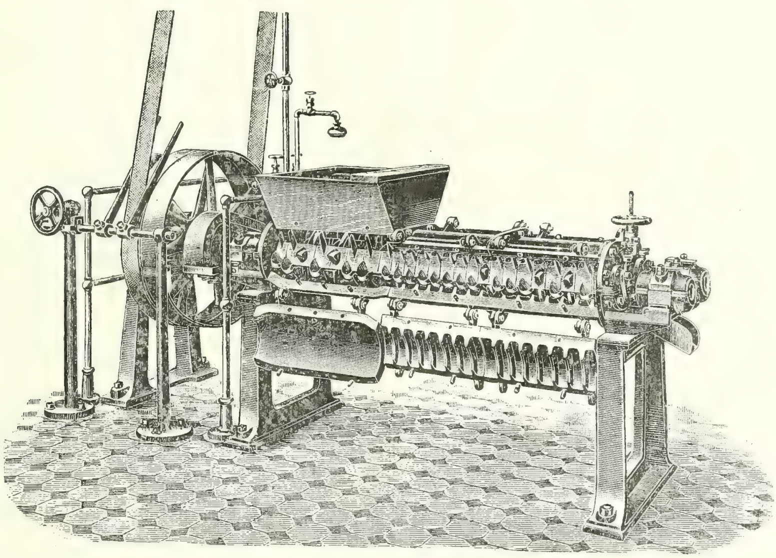
In this machine, a slowly revolving drum, covered with wire gauze, is placed in a vat to which the pulp from the sorters, mixed with the necessary quantity of water, is conducted. The pulp, which deposits itself on the wire, is removed by means of a felt; it is further freed from water by pressing between rollers, and finally wound round a cylinder, from which it is cut off as soon as the sheet has reached a certain thickness.

Mechanical wood pulp may be bleached by the use of a solution of either sodium or calcium bisulphite. Wood pulp, if purchased in a moist condition, may be fed into the beater without any previous treatment, but if the pulp has been dried the dry boards first must be soaked in hot water and then ground in an edge runner, or must be torn into small pieces by means of a special disintegrator and then thrown into the beater.

Brown Mechanical Wood.

Brown mechanical wood is a fibrous material which is practically intermediate in character between mechanical wood pulp and wood cellulose; it was first prepared in 1868 by Moritz Behrend in Prince Bismarck's paper mills in Varzin. Although considerably darker in colour than the ordinary mechanical wood, this material is of a more fibrous nature and therefore possesses superior felting properties. It is extensively used as a substitute for hemp and jute in the manufacture of cheap brown wrappings.

Fig. 11.



Chemical Wood Pulp or Wood Cellulose.

So-called "wood cellulose" or "chemical wood pulp" is distinctly different in action from mechanical wood pulp, and is prepared by subjecting wood to a chemical treatment; of the numerous processes for its manufacture which have been discovered and patented, but few have found technical application. I will only mention the processes of Watt-Burgess (1853), and of Houghton (1857), in which wood is treated with aqueous solutions of alkalis, Jullion's (1855), Blitz's (1883), and Dahl's (1884) processes, in which alkaline

sulphides are used, and lastly, those devised by Tilghmann (1866), Mitscherlich (1874), Ekman (1881), Francke (1881), and Graham (1882), in which bisulphites are the chemical agents employed for the disintegration of the wood. The wood cellulose is called "soda wood," "sulphate wood," or "sulphite wood," according to the particular type of process which has been used in its manufacture. The fibres of chemical wood are, practically speaking, pure cellulose, they possess excellent felting properties, and may be readily bleached. Wood cellulose may be counted among the best substitutes for rags, and its application has become so general that it would be difficult to name the kinds of papers to which its use is confined. In "news" and other cheap papers it acts as a binding agent to hold the mechanical wood together; in "writings" and "printings" it is necessary to blend it suitably with other fibres, such as straw, cotton, &c., in order to overcome its transparency. This latter property, however, has made the wood cellulose a most valuable material for the manufacture of imitation parchment and of "butter," "grease proof," and tracing papers. Papers made from wood cellulose are closely felted and of a uniform appearance, they take an excellent finish and colour, present a good smooth surface, and have a good feel.

The manufacture of wood cellulose has developed into an enormous industry, and although the description of details lies outside the scope of these lectures, I will endeavour to sketch the outlines of the various typical processess in use at the present time. In the soda process, the wood, freed from bark, knots, &c., is cut into pieces of suitable size, and is usually boiled in vertical stationary boilers with caustic soda lye, under high pressure (60 to 150 lbs. per square inch). The boiling is followed by a preliminary washing in the boiler, and the washing and bleaching of the pulp are generally completed in the Hollander, from which the pulp is transferred to a cylinder machine and converted into boards. The soda lye from the boiling, as well as the first wash water, are subsequently dealt with in the soda recovery plant, as described under straw.

The Sulphate Processes.—The sulphate processes, in which sodium sulphate and caustic soda are primarily employed as boiling agents, differ generally speaking in minor details only from the alkali processes, the construction of the plant and the treatment being in the main similar. A superior and stronger pulp is, however, obtained by the sulphate process.

The Sulphite Processes.—The use of liquid sulphurous acid proposed by Pictet has for various reasons found no practical application. Tilghman, in his patents of 1866 and 1867, describes the use of aqueous solutions of sulphurous acid for the manufacture of cellulose from wood and other fibrous materials.

As early as 1874 Ekman applied magnesium bisulphite, whilst the credit of having introduced the cheaper calcium bisulphite for this purpose is due to Dr. A. Mitscherlich, who, according to Hofmann, produced cellulose on a commercial scale by means of this process in 1874. To ensure uniform resolution of the ligno-celluloses it is essential to chip the wood, after it has been freed from bark and knots, into small pieces and to pass these through crushing rollers and sorters. The boiling liquor, which consists of a solution of either calcium or magnesium bisulphite, is prepared by the action of sulphur dioxide on calcium or magnesium carbonate or on an aqueous solution of calcium or magnesium oxide respectively in water.

For the preparation of the sulphur dioxide required, sulphur is burned, or pyrites are roasted in specially-designed ovens which are supplied with such a quantity of air as contains the amount of oxygen required to form sulphur dioxide. After leaving the oven, the gas is cooled and washed. Large towers are used for the preparation of the bisulphite liquor from either limestone or from dolomite (magnesia limestone); these are filled with the stone, and a continuous stream of water is allowed to flow downwards whilst the sulphur dioxide enters the tower from below. The bisulphite liquor, prepared by this method, flows into a tank placed at the bottom of the tower.

The other method of preparing bisulphite liquor consists in passing sulphur dioxide into milk of lime contained in closed vessels provided with stirrers; the gas passes through a series of these vessels in succession, and the operation is so conducted as to ensure complete absorption of the dioxide, whilst the atmospheric nitrogen escapes from the last vessel.

The three principal forms of boilers, the upright stationary, the cylindrical, and the spherical rotary, are used as digesters in the manufacture of sulphite cellulose, but to protect the metal against the destructive action of the acid it is found necessary to line the boilers

with an acid-resisting material. Lead was formerly used for this purpose, but has now been superseded by more serviceable materials, such as Wenge's composition—consisting of Portland cement and sodium silicate—Kellner's composition-cement, with ground slate or glass, and many others.

The time of boiling, the strength of the liquor used, and the pressure, vary considerably in the different works; whilst in some instances the wood is digested during three days at a pressure of 45 lbs. per square inch, in others, the treatment is completed in one day, at a pressure of 90 to 100 lbs. The wood, as it comes from the digester, is still further treated in order to bring about a complete separation of the fibres, and the pulp is finally washed and bleached in the ordinary breaker. In the bleaching of sulphite wood a difficulty often presents itself in the appearance of a reddish brown colour, which strongly resists the action of the bleaching liquor; this may be readily avoided by treating the pulp with a solution of caustic soda or sodium carbonate as a preliminary to the actual bleaching.

Miscellaneous.

*SCIENTIFIC INSTRUCTION.**

The Section over which I have the honour to preside deals with every branch of education. It is manifest that in an address your President cannot deal with all of them, and it remained for me to choose one on which I might remark with advantage. As my official work during the last thirty-three years has been connected with education in science, I think I cannot do better than take as my subject the action that the State has taken in encouraging this form of education, and to show that through such action there has been a development of scientific instruction amongst the artisan population and in secondary day schools. The development may not indeed have been to the extent hoped for, but it yet remains that solid progress has been made.

I have chosen the subject deliberately, as I find that there are very few of those who have the interests of education strongly at heart, or who freely criticise those who have borne the burden of the past, that have any knowledge of the trials and difficulties (some of its own creating, but others forced on it by public opinion) which the State, as represented by the now defunct Science and Art Department, had to contend with in its unceasing missionary efforts in the cause of scientific instruction. I shall not attempt to do more than show that whatever its defect may have been in tact, whatever its shortcomings in method, that Department still deserved well of the country for the work that it did in regard to the fostering of scientific instruction in the country at large.

As far back as 1852 the Government of the day, influenced very largely by the Prince Consort, realised that it had an educational duty to perform to the industrial classes. Whether it was influenced by philanthropic motives or from the evidence before it that if Great Britain was to maintain its commercial and industrial supremacy scientific instruction was a necessity, it matters little. The fact remains that it determined that the industrial classes should have an opportunity of acquiring that particular kind of knowledge which would be of service to them as craftsmen. In this year. 1852, the Speech from the Throne contained these words: "The advancement of Fine Arts and of Practical Science will be readily recognised by you as worthy of a great and enlightened nation. I have directed that a comprehensive scheme shall be laid before you, having in view the promotion of those objects towards which I invite your aid and co-operation."

It is somewhat remarkable that the then Ministry, of which Lord Derby was the chief and Mr. Disraeli the Chancellor of the Exchequer, did not survive to promulgate the scheme, which proposed theoretical rather than practical science, but that their successors, under Lord Aberdeen, issued it and commenced to carry it into effect. In 1853 the Department of Science and Art was established under the direction of Mr. Cole. Since 1835 so-called Schools of Design had been in being. These came under the new Department, and it was determined to establish science classes for instruction in science, Dr. Lyon Playfair, the well-known chemist, being charged with the duty. Playfair resigned in 1858, and in 1859, Mr. Cole induced a young Engineer officer, Lieut. Donnelly, to undertake the inspection and organisation of science instruction throughout the country. It was through this officer's untiring energy and zeal that the classes in science flourished and were added to at this early stage of the new Department's history. The same energy was displayed by Donnelly during the whole of his long career in the service of the State, and I feel that it was fortunate for myself to have served so many years as I did under one to whom the country at large owes a deep debt of gratitude.

Not long ago he passed away from us, and there will be no more lasting memorial to him than that which he himself erected during his lifetime in the fostering that form of education which is of such vital importance to the national well-being.

To revert to history, I may record that the first science examinations conducted by the State took place in May, 1861, and the system of grants being made on the results of examination having been authorised, the magnificent sum of £1,300 was spent

* From the Address to the Educational Science Section of the British Association, by Sir William de W. Abney, K.C.B., D.C.L., D.Sc., F.R.S., President of the Section. (Southport, 1904.)

on this occasion on the instruction of 650 candidates, that number having been examined. Thus early was the system of examination commenced in the Department's career, and the method of payments on the results of these examinations stereotyped for many years to come. There is reason to believe that the educational experts of that day considered that both were essential and of educational value, a value which has since been seriously discounted. Employers of labour in this country were not too quick in discerning the advantages that must ultimately ensue from this class of education if properly carried out and encouraged. Theoretically they gave encouragement, but practically very little, and this survives to some extent even to the present day. Some of the foremost employers, however, gave material encouragement to the formation of classes, insisting on their employees attending evening instruction; but conspicuous above all was Mr. Whitworth, who, in 1868, placed in the hands of the Department the sum of £100,000, to be devoted to the creation of scholarships, which were to be awarded at the annual May examinations. The proviso made by him was that all competitors were to have had experience in practical work in an engineering establishment. Such candidates, it was evident, must have found out their own weakness in education, and, by working in science classes, could make up their deficiencies, and the award of these scholarships would enable them to study further. Sir J. Whitworth was far-seeing and almost lived before his age, but the benefits that he has conferred, not only on individuals, but on science and industries, by his generosity will make his name to be remembered for generations to come. To have been a Whitworth scholar gives an *entrée* into various Government and engineering posts, and we have in the front rank of science men who have held these scholarships and whose names stand prominent in the development of engineering.

Incidentally, I may say that no country but this, for very many years, considered that instruction in science for the artisan was a large factor in maintaining and developing industry. The educational interests of the employer and the foreman were, in some countries, well provided for, but the mechanic was merely a hand, and a "hand" trained in merely practical work he was to remain. He could not aspire to rise beyond. We may congratulate ourselves that such a "caste" system does not exist amongst ourselves.

For the first twenty-five years of the Department of Science and Art the grants given by Parliament for science instruction were distributed almost entirely amongst those who were officially supposed to belong to the industrial classes, and no encouragement was offered to any higher class in the social scale.

It would take me too long to show that at first the industrial classes were very shy of seizing on the advantages offered them. Suffice it to say that they had to be bribed by the offer of prizes and certificates of success to attend instruction, and it was not for several years that the evening classes got acclimatised and became popular.

The evening instruction was then largely attended by adults. That this was the case may be judged by the fact that the average age of candidates who obtained successes in advanced chemistry was about twenty-five, and in elementary chemistry about twenty-one. I have alluded to the apathy displayed by employers and by the artisans in the early days of the Department of Science and Art. The causes which dispelled it in both employers and employed, in regard to science instruction, will be found in the following extract from a report by the Department of Science and Art:—

"The Paris Exhibition (1867) caused the work of this country to be brought into close comparison with that of the rest of the Continent, and in many points both of manufacture and of skilled labour it was found England did not stand in such a good position as she had done a few years back. Dr. Playfair, in a letter to the *Times*, drew attention to this, attributing much if not all the evil to the deficiency of our technical education among the artisan class. The substance of this letter was taken up by many persons of influence during the autumnal recess, and it led to a sort of educational panic, the cry for technical education becoming quite the absorbing topic among all circles and forming a considerable portion of the contents of all periodicals. Meetings were convened and addresses delivered all over the country, and the question was so much ventilated that important changes were anticipated in the educational arrangements of the country during the coming session of Parliament, which unfortunately were put off on account of the debates on the Reform Bill of 1868.

"The agitation necessarily brought forward the work of the Science Division of the Science and Art Department, and it is not a little remarkable how completely the system which had been growing up since 1860 seemed to meet all the requirements of the case, and at the same time how few persons had any idea of its provisions in spite of all that had been done to spread a knowledge of the scheme.

"There can be no doubt, however, but that this six years' work had silently, though materially, effected a change in the general tone of feeling on the subject of scientific education, and had been the means of preparing the country for the 1867 agitation. The different feeling among the working-classes on the subject is forcibly shown in the Annual Report of the Science and Art Department. From this it appears that in 1860 a pupil in one of the science classes in Manchester, a town usually looked upon as in advance of others, could hardly continue his attendance at the class owing to the taunts of, and ill-treatment by, his companions. Nevertheless, in the autumn of this year, 1867, hardly enough could be said or done to satisfy the desire for science classes being formed for those very persons who, but six years before, had considered attendance at a Government science school as almost against the rules of their trade."

Such was the account of 1867 given by Mr. G. C. T.

Bartley (now Sir G. Bartley, M.P.). The plan adopted by the Science and Art Department for encouraging instruction in science was perhaps the best that could be devised at the time, though we now know that it was capable of improvement. It may be mentioned that an improvement in it was made the next year by the introduction of a very large system of scholarships, scholarships which have enabled the possessors in some instances to continue their studies at universities, and several distinguished men owe their positions to this aid. It was in this same year that Mr. Whitworth established his scholarships, as before described.

I have endeavoured to give a brief *résumé* of what was done during the first fifteen years of the existence of the Science and Art Department, and it continued to expand its operations after 1868 on the same lines for another ten years. In 1876 your President became connected with the Department as a Science Inspector. I am sure the Section will forgive me if I am somewhat personal for a few moments. During the previous eight years I had had the honour of being a teacher of some branches of physical science at the School of Military Engineering, and my own training was such that I had formed a very definite opinion as to how science instruction should be imparted, both to those who had a good general education and also to those who had not. The method was the same in both cases: it should be taught practically. I may say that though I had not myself had the advantage of being taught it at school, I had learned all the science I knew practically, and I entered the Department fully impressed with this view. Whenever possible I have till the present time endeavoured to impress this view on all who were interested in the work of the Department. Much of the science that was taught in State-supported classes was largely book work and cram, and the theoretical instruction as a rule was unillustrated by experiment. This was undoubtedly due to the system of payments being based on success at the examinations. I must here say that there were honourable exceptions to this procedure. There were teachers, then as now, who knew the subjects they taught, and who were inspired by a genuine love of their calling. I can in my mind's eye recall many such, some of whom have joined the majority, and others who are still at work and as successful now as then in rousing the enthusiasm of their students.

I am not one of those who think, as some do, that cramming is entirely pernicious. A good deal of what used to be taught at public schools in my days was cram. It served its purpose at the time in sharpening the memory, and was a useful exercise, and it did not much matter if in after years much of it was forgotten. If the cramming is in science, a few facts called back to mind in after life are better than never having had the chance at all. In fact, as the faded beauty replied to the born plain friend, it is better to be one of the "have beens" than a "never wasn't."

It was determined to make a vigorous onslaught against teaching that was unillustrated by experiment and to encourage practical teaching as far as could be done. Proper apparatus for illustrating lectures was insisted upon, and, with aid from the Department, was eventually provided, though in some instances several years' pressure had to be exercised before it was obtained. I am bound to say that in many instances after it had been procured a surprise visit by the inspector during the hours of instruction often found that the lecture table was free from all encumbrance, and that the dust of weeks was upon the apparatus that should have been in use. This was sometimes due to the inability of the teacher to use the apparatus rather than to a wish to disregard the rules laid down by the Department; but usually it was due to the fact that the teacher found cram paid best. I should like to say here that this state of things does not exist at the present time, and that the training of science teachers by the Royal College of Science and by other institutions has completely broken down the excuses that were often offered at that time.

The first grants for practical teaching were paid for chemistry. The practical work had to be carried out in properly fitted laboratories. There were not half-a-dozen at the time which really answered our purpose, and one of the earliest pieces of work on which I was engaged was in assisting to get out plans for laboratory fittings. These were very similar to those which I had designed for the School of Military Engineering several years before. Thanks to the Education Act of 1870 (I speak thankfully of the work that some of the important School Boards have done in the past in taking an enlightened view of science instruction) there were some localities where the idea of fitting up laboratories was received with favour, and it was not long before several old ones were refitted, in which instruction to adults was given, and new ones established in Board schools for the benefit of the Sixth Standard children. At that time an inspector's, like the policeman's, lot was not a happy one. We had to refuse to pass laboratories which did not fulfil conditions, though we left very few "hard cases."

Till after the passing of the Technical Instruction Act in 1887, the Department aided schools in the purchase of the fittings of laboratories (both chemical and others), and year after year this help, which stimulated local effort, caused large numbers of new laboratories to be added to the recognised list. After six or seven years we had a hundred or more laboratories (both chemical and others), and year after year this help, which stimulated local effort, caused large numbers of new laboratories to be added to the recognised list. After six or seven years we had a hundred or more laboratories at work of what I may call "sealed-pattern efficiency." I am not very partial to sealed patterns, but they are useful at times, for they tell people what is the least that is expected from them. The pattern was not without

its defects; but laboratories, like other matters, follow the law of evolution, and the more recently fitted ones show that the experience gained whilst teaching or being taught in a sealed-pattern type has led to marked improvements. Personally, I am of opinion that only necessaries should be required, and I rebel against luxuries; for a student trained by means of the latter will, as a rule, in after life fail to meet with anything beyond the mere essentials for carrying on his scientific work.

The sealed pattern is practically in abeyance, though it can be trotted out as a bogey, and any properly equipped laboratory is recognised as long as it meets the absolute necessities of instruction.

The half-dozen chemical laboratories which existed in 1877 have now expanded to 349 physical and 774 chemical laboratories. These are spread over all parts of England. I leave out Scotland and Ireland, as the science teaching is no longer under the English Board of Education.

It is only fair to say that many of this large number of laboratories are at present in secondary schools, regarding which I shall have to speak more at length. But the fact remains that in twenty-seven years there has been such a growth of practical science teaching that some 1,120 laboratories have come into being. My predecessor in the Chair likes to call laboratories "workshops." I have no objection, but the reverse; for the word "laboratory," like "research," sounds too magnificent for what is really meant, and all education should more or less be carried out in workshops.

The increase is as satisfactory as it is remarkable. It is only possible to increase the numbers in early days by gentle pressure and prophesying smooth things which, happily, did eventually come to pass. In later days the increase has been almost automatic. The Technical Instruction Act has called into being technical instruction committees who, in many cases, have taken up science instruction in their districts in earnest. They, too, have had public money to allocate, and not a little has gone in the encouragement of practical education. It may, however, be remarked that had it not been for the preliminary work that had been done by the Science and Art Department, it is more than probable that the Technical Instruction Act of 1887 would never have seen the light.

A reference must now be made to the removal of what anyone will see was a great bar to the spread of sound instruction in every class of school where science was taught. So long as the student's success in examination was the test which regulated the amount of the grant paid by the State, so long was it impossible to insist on all-round practical instruction. It was impracticable to hold practical examinations for tens of thousands of students in some twenty different subjects of science. The practical examination in chemistry told its tale of difficulties. It was only when the Duke of Devonshire and Sir John Gorst in 1898 substituted for the old scheme of payments, payment for attendance, and in a large measure substituted inspection for examination, that the Department could still further press for practical instruction. For all elementary instruction the test of outside examination does more harm than good, and any examination in the work done by elementary students should be carried out by the teacher, and should be made on the absolute course that has been given. It seems to be useless or worse that an examination should cover more than this. Instruction in a set syllabus which for an outside examination has to be covered spoils the teaching and takes away the liberty of method which a good teacher should enjoy. The literary work involved of answering questions for an outside examiner, is also against the elementary student's success, and cannot be equal to that which may properly be expected from him a couple of years later.

Advanced instruction appears to be on a different footing. The student in advanced science must have gradually obtained a knowledge of the elementary portions of the subject, and it is not too much to ask him beyond the inspection of his work to express himself in decent English and submit to examination from the outside; but even here the payment for such instruction should be by an attendance grant tempered in some degree by the results of examination, since examiners are not always to be trusted.

The attendance grant was not viewed by some with great favour at first, and protests were received against its adoption, a favourite complaint being that it was sure to entail a loss of grant. One became suspicious that some of those who protested were aware that the last bulwark which defended the earning of grants by cram was being removed, and that inspection might prove more irksome than examination. This is past history now, and the new system works as smoothly as the old, and with not more complaints than are to be always expected.

As I have said, grants were for very many years supposed to be confined to aiding the instruction of the industrial classes, but this limitation was more nominal than real. It might probably be imagined that it was no very difficult task to distinguish an artizan and his children from students who belonged to the middle classes. This was not the case, however. Children belonging to the industrial classes were, on joining a science class, obliged to state the occupation of the father, and it was no uncommon thing for fathers to be given brevet-rank by their children. Thus, a bricklayer's son would describe his father as a "builder," which, if true, ought to have brought him into the ranks of the middle class. These unauthorised promotions were one of the difficulties the inspector had to face when judging as to the status of the parents. This difficulty was largely met by a rule that all those who attended evening classes were supposed to be of the industrial class; but as the day classes increased the numbers of those who by no possibility could be of the artizan class also increased, and it became a very invidions duty of the inspector to put M.C. (middle class)

against the names of many. It was determined by superior authority that only those students or their parents who could claim exemption from income-tax, should be reckoned as coming within the category of industrial students. In early days, the qualification for abatement on income-tax was a much lower figure than it is to-day, and almost each succeeding Chancellor of the Exchequer has raised the figure of the income on which the abatement could be claimed. To-day it is, I believe, £700 a year, bringing the official definition as to membership of the industrial classes to an absurdity. It became evident to the official mind, which some people are good enough to say works but slowly, that the definition must be amended, or the limitation abolished. The progress of events happily made the abolition the better plan, and was the means of allowing inroads of science instruction to be made into secondary day schools.

The history of these inroads I shall now give. Instruction given in so-called organised science schools was originally aided by the Department by means of a small capitation grant. These schools were supposed to give an organised course of science instruction, and the successes at examination determined the payment. They were not satisfactory as at first constituted, and they so dwindled away in numbers that in 1890 only some one or two were left. A small increase in the capitation grant in 1892 revived some of them, and a fair number existed in the following year. There was no doubt, however, that the conditions under which they existed were most unfavourable for a sound education, which ought not only to include science but also literary instruction. The latter was, in many schools, wholly neglected, owing to the fact that the grants earned depended on the results of examination, and so all the school time was devoted to grant earning.

Mr. Acland, at this time Minister for Education, was made aware of this neglect to give a good general education, and as I was at that time responsible for science instruction, I was directed to draw up a scheme for reorganising these schools and forcing a general as well as scientific education to be carried out. Baldly the scheme abolished almost entirely* payments on results of examination, and the rate of grant depended on inspection and attendance. Further, a certain minimum number of hours had to be given to literary subjects, and another minimum to science instruction, a great deal of it being practical and having to be carried out in the "workshop." The payments for science instruction were to be withheld unless the inspector was satisfied that the literary part of the education was given satisfactorily.

The scheme was accepted and promulgated whilst the Royal Commission on Secondary Education was sitting, and, if I may be allowed to say so, Mr. Acland's tenure of office would be long remembered for this innovation alone, since in it he took a wide departure from the traditional methods of the Department and created a class of secondary school which differed totally from those then existing. Needless to say the scheme was not received with favour on all sides, more especially by those who thought that serious damage would be done to secondary schools by the competition from this new development of secondary education. I am not ashamed to say that the disfavour shown on some sides made me rejoice, as it indicated that a move had been made in the right direction. At first it was principally the higher-grade Board schools that came under the scheme, and in the first year there were twenty-four of them at work. This type of school gradually increased until about seventy of them, and chiefly of a most efficient character, were recognised in 1900. Their further increase was only arrested by the Cockerton judgment, now so well known that I need only name it. But here we come to a most interesting development. State aid, as already said, was at first limited to instruction of the industrial classes, but no limitation as to the status of the pupil was made in this new scheme for the schools of science, and logically this freedom was extended in 1897 to all instruction aided by the Department—the date when all limitation as to the status of the pupil was abolished, the only limitation being the status of the school itself. Thus, if a flourishing public school, charging high fees for tuition, were to apply to participate in the grant voted by Parliament, it may be presumed, it would have to be refused. The abolition of the restriction as to the status of the pupils left it open to poorly endowed secondary schools to come under the new scheme. To a good many the additional income to be derived from the grant meant continuing their existence as efficient, and for this reason, and often, I fear, for this reason alone, some claimed recognition as eligible.

Such is an outline history of the invasion of science instruction into certain secondary schools—an invasion which ought to be of great national service. In my view no general education is complete without a knowledge of those simple truths of science which speak to everyone, but usually pass unheeded day by day. The expansion of the reasoning and observational powers of every child is as material to sound education as is the exercise of the memory, or the acquisition of some smattering of a language. I am not going into the question of curricula in schools, as I hope, regarding them, we shall have a full discussion. But of this I am sure, that no curriculum will be adequate which does not include practical instruction in the elementary truths of science. The President of the Royal Society, in his last Annual Address, alluded to the mediæval education that was being given in a vast number of secondary schools. Those who planned the system of education of those times deserve infinite credit for including all that it was possible to include. Had there been a development of science in those days, one must believe that, with the far-seeing wisdom they then displayed, they would

* Within the next four years they will entirely cease.

have included that which it is the desire of all modern educationists to include. Observational and experimental science would have assuredly found a place in the system.

One, however, cannot help being struck by the broadening of views in regard to modern education that has taken place in the minds of many who were certainly not friendly to its development. Perhaps in the Bishop of Hereford, when headmaster of Clifton, we have the most remarkable early example of breadth of view, which he carried out in a practical manner, surrounding himself with many of the ablest teachers of science of the day. There are other headmasters who, though trained on the classical side, have had the prescience to follow in his footsteps, and of free will; but others there are who have neither the desire nor the intention, if not compelled to do so, to move in the direction which modern necessities indicate is essential for national progress. I am inclined to think that the movement in favour of modernising education has been very largely quickened by the establishment of schools of science in connection with endowed schools and the desire for their foundation by the Technical Instruction Committees, who had the whisky money at their disposal, and who more than supplemented the Parliamentary grants which these schools were able to earn. It was the circumstance that the new scheme was issued when many endowed schools were in low water that made it as successful as it has been.

The number of schools of science increased so rapidly that it appeared there might be a danger of too many of this type being started on sufficient educational grounds. Science instruction was carried in them to such an advanced point and so many hours of the week were spent on it that they became in some degree specialised schools. At least eight hours a week had to be devoted to science, ten to literary instruction, and five to mathematics—any further time available could be spent on any section that was considered desirable. For some pupils the time devoted to science is barely enough, but for others who intend to follow careers in which the literary section should predominate it appeared that some curtailment of hours in the science section might be usefully allowed, and it became a question how far such instruction might be shortened without impairing its soundness. After much anxious thought it was considered that four hours per week, besides mathematics, was the very least time that ought to be devoted to such instruction, and that the latter part of it should be practical work. A scheme embodying this modification was approved by the Lord President and the Vice-President whilst I was Principal Assistant Secretary for Secondary Education, and smaller grants than those for schools of science were authorised in 1901 for those schools who were prepared to adopt it. By the scheme instruction has to be given only in such subjects and to such an extent as is really necessary to form part of that general education of ordinary students who might not have to follow industrial pursuits. This modified and shortened course has met with unqualified success. Some 127 schools came under the scheme the first year, and I gather that there will be a considerable increase in numbers in the futnre. The establishment of schools of science and of these schools may be considered to be a great step in getting practical instruction in natural knowledge introduced into secondary schools. The leaven has been placed in some 300 of them, and we may expect that all schools which may be eligible for State aid will graduaily adopt one scheme or the other. Though it is said there is nothing in a name, I am a little doubtful as to whether the earmarking of science education as distinct from secondary education is not somewhat of a mistake at the present day. For my own part, I should like to think that the days have passed when such an earmarking was necessary or advisable. The science to be taught in elementary schools should be part and parcel of the secondary education, and it would be just as proper to talk of Latin and Greek instruction apart from secondary education as it is to talk of science instruction. One of the causes of the unpopularity of the Science and Art Department was its too distinctive name. At the same time, it would be most unwise at the present time, when the new Education Committees are learning their work, and looking to the central authority for a lead, for the State to alter the conditions on which it makes its grants to these schools. It will require at least a generation to pass before modernised education will be free from assault. If science instruction is not safeguarded for some time to come it runs a chance of disappearing or being neglected in a good many schools. As to the schools which have no financial difficulties, it is hard to say what lines they may follow. Tradition may be too strong in them to allow any material change in their courses of study. If it be true that the modern side of many a public school is made a refuge for the "incapables," and is considered inferior to the classical side, as some say is the case, such a side is practically useless in representing modern education in its proper light. Again, one at least of the ancient universities has not shown much sympathy with modern ideas, and so long as she is content to receive her students ignorant of all else but what has been called mediæval lore, so long will the schools which feed her have no great inclination to change their educational schemes.

If we would only make the Universities set the fashion, the public schools would be bound to follow. The Universities say that it is for the public schools to say what they want, and *vice versâ*, and so neither one nor the other change. It appears to me that we must look to the modern universities to lead the movement in favour of that kind of education which is best fitted for the after life of the large majority of the people of this country. If for no other reason, we must for this one hail the creation of two more universities where the locali-

ties will be able to impress on the authorities their needs. The large majority of those whose views I share in this matter are not opposed to or distrust the good effects of those parts of education which date from ancient times. The great men who have come under their sway are living proofs that they can be effective now as they have been in times past, but we look to the production of greater men by the removal of the limitations which tradition sets. I myself gratefully acknowledge what the public school at which I had my early education did for me, but I think my gratitude would be more intense had I been given some small elementry instruction in that natural knowledge which has had to be picked up here and there in after life.

There is one type of college which I have not alluded to before, and that is the technical institutes. These have been fostered by the localities in which they are situated, and been largely supported by the whisky money, supplemented by Government aid. I am glad to see that in the last regulations of the Board of Education these colleges will receive grants for higher scientific instruction, and I have no doubt that in the near future such institutions and schools of science will receive a block grant, which will give them even still greater freedom than they now enjoy. These are colleges to which students from secondary schools will gradually find their way, where they wish for higher education of a type different from that to be gained at a university.

I have endeavoured to give a brief historical sketch of what the State has done in helping forward instruction in natural knowledge amongst the industrial classes, adults and children, and how gradually its financial aid has been extended to secondary schools. I have also endeavoured to indicate the steps by which practical instruction has been fostered by it. I have done this because I am confident that ninety-nine educationists out of every hundred have but little idea what the State has been doing for the last fifty years. Some connected with secondary schools —I have personal knowledge—were till lately ignorant that the State had offered advantages to them of a financial nature. I may say that the work of the late Science and Art Department was largely a missionary work. It was abused, sometimes rightly but more often wrongly, for this very work, and it had more abusers at one time probably than any other Government Department. Even friends to the movement of modernising education found fault with it as antiquated and slow, but I can assure you that no greater mistake can be made in pressing forward any movement by any hurried change of front or by endeavouring to push forward matters too rapidly. In the first place, the Treasury naturally views untried changes with suspicion, and this fact has to be dealt with more particularly when there is no great expression of public opinion to reckon with. At the same time it cannot be stated too strongly that the Treasury has in recent years dealt in a friendly and enlightened spirit with all matters which could affect the spread of science. Again, there is a hostility to great and rapid changes in the minds of those whom such changes affect.

The policy must always be to progress as much as is possible without rousing too great an opposition from any quarter, and I think it will be seen that the progress made during the last twenty-five years has, by the various annual increments, been perhaps more than could have been hoped for, and gives a promise for even more rapid advances in the future.

CUSTOMS REPORT.

The forty-seventh report of the Commissioners of His Majesty's customs for the year ended 31st March, 1903, lately published, contains the following particulars:—

The Gross Imperial Customs Revenue collected in the year 1902-3 amounted to £35,499,723, or, after deduction of Drawbacks and Repayments, to £34,460,685. This is £3,414,125 more than the produce of 1901-2, and £739,315 less than the Budget Estimate for the year. The Customs Revenue has thus brought in 2·1 per cent. less than was anticipated, but nearly 11 per cent. more than it produced in 1901-2, and very much more than was ever raised in this country before, by Customs duties, in any one year.

The amount which was paid to the Exchequer in 1902-3 was £34,433,000, which compares with £30,993,000 in 1901-2, showing an increase of £3,440,000.

The gross and net receipts from the duty on exported coal, culm, coke, and cinders in the two years since its imposition were:—

—	1901-2.	1902-3.
	£	£
Gross receipts	1,859,410	2,266,163
Net receipts	1,311,706	1,991,767

The increase of £680,061 in the net receipts in 1902-3 is chiefly due to the lessened quantities of coal exempted from duty, or on which the duty was remitted, under the pre-duty contract clause.

The duty upon foreign chicory produced £53,012 in 1902-3, a small decrease as compared with the preceding year.

Cocoa of all sorts yielded in duty £225,816, a decrease as compared with 1901-2, of £29,485, or 11·5 per cent.

The falling off has occurred principally in connection with raw cocoa, the clearances of which were 8,041,652 lbs. smaller in 1902-3 than in 1901-2. The larger clearances of 1901-2 took place in January and February, 1902, and were chiefly due to War Office

demands for the South African campaign, and to Budget anticipations.

The gross receipts from the duty upon coffee in 1902-3 were £194,152, and the net receipts £178,628. The gross receipts show a decrease of £26,749, or 12·1 per cent., whilst the net receipts show an increase of £4,286, or 2·5 per cent., as compared with 1901-2, the cause of these movements being due largely to the reduced quantities sent away on drawback, owing to the cessation of the South African war.

The net yield of the corn duties amounted to £2,346,796, of which wheat and wheat flour contributed 58·6 per cent.

The imports of wheat in the financial year 1902-3 were 8½ million cwts., and were the highest yet recorded, but the imports of wheatmeal and flour were lower than they have been for some years. Partly owing to the failure of the North American maize crop of 1901, the imports of maize in 1902-3 were lower than they have been since the year 1895-6.

The currant crops of 1902 were both good in quality and quantity, and the receipts from the duty have exceeded those of 1901-2 by £14,585, or 14·4 per cent. The amount received in 1902-3, viz. £115,524, is not, however, equal to the receipts o 1898-9 and 1899-1900—the two years preceding the unfavourable crop of 1900, which was so much damaged by *peronosporos*. Prices of currants were much lower than in 1901.

Duties upon sugar, glucose, molasses, saccharin, and articles manufactured with or preserved in sugar, were imposed by the Finance Act of 1901, and the year 1902-3 was consequently the second during which the duties have been in force.

The duties upon glucose were originally fixed at 2s. the cwt. for liquid glucose, and 2s. 9d. the cwt. for solid glucose, but in consequence of the imposition of the Corn Duties, it became necessary to add to these amounts in order that the home manufacturer should not be placed at a disadvantage as compared with his foreign competitor. The Finance Act of 1902 accordingly raised the rates to 2s. 6d. and 5s. 3d. respectively.

The net receipts from the Sugar duties in 1902-3 were £4,478,707, as against £6,399,228 in 1901-2, a decrease of £1,920,521, or 30 per cent. This very large reduction is due chiefly to forestalments or postponement of clearances in anticipation of changes of duty These operations resulted in an abnormal reduction of the revenue of 1902-3 by about £1,500,000.

The revenue from the tea duty in the last financial year was £5,975,483, as against £5,792,967 in 1901-2, an increase of £182,516, or 3·2 per cent. Towards the end of the year 1902-3 it was generally anticipated in the trade that the duty, which had been increased from 4d. to 6d. per pound in 1900, would be reduced, and clearances were postponed. Had this not occurred the increase would have been somewhat greater.

The crops of 1902 were not so large as was originally expected, and prices, which during the summer and autumn had been at a very low level, rose in consequence. Between July, 1902, and February, 1903, the rise in price may be put at 1½d. per lb., the London sales of Indian tea in the latter month averaging 7⅞d. per lb., and of Ceylon tea 7⅝d. per lb.

The exports of tea from the United Kingdom during the financial year 1902-3 have been about 4,600,000 lbs. in excess of those of the preceding year, and this has also helped to raise the price.

Of the total revenue in 1902-3, tea from India contributed 57·8 per cent.; tea from Ceylon, 34·2 per cent.; tea from China, 4·6 per cent.; and tea from all other countries, 5·4 per cent.

The duties upon tobacco realised £12,451,473 in 1902-3, as compared with £10,5667,705 in the year 1901-2, an increase of £1,883,768, or 17·8 per cent. This large increase is not, however, wholly due to greater consumption, for the clearances of 1901-2 were considerably reduced by the forestalments which were made at the end of 1900-1 in anticipation of a rise in the duties. It is probable that, if allowance be made for those forestalments, the increase in 1902-3 would be about 3 to 3½ per cent.

The wine duties yielded £1,523,856 in 1902-3, an increase of £74,169, or 5·1 per cent., as compared with the receipts of 1901-2. The consumption of wine showed a downward tendency during 1900 and 1901, and the improvement of 1902-3 may to some extent be attributed to the cessation of the war.

General Notes.

An Early Purple Fishery.—The island of Leuke, off the south-east coast of Crete, an important fishing-station in antiquity, has recently been explored by Mr. C. T. Currelly and Mr. R. C. Bosanquet. Among sand-hills on the north shore they found a bank of shells, some whole but mostly crushed, of the variety *Murex trunculus*, which is known to have been used in the manufacture of the purple dye. Scattered through the heap were fragments of pottery and of a stratile bowl, which marked it as not only præ-Hellenic but præ-Phœnician. Further digging within a few yards of the heap brought to light characteristic Cretan vases of the Kamáres type and the foundations of a house. The evidence shows that the extraction of the purple-juice was practised in Crete at least as early as 1600 B.C. Hitherto the Phœnicians have been credited with the discovery of "Tyrian purple." It appears, however, that in this matter, as in the art of writing, and perhaps in other inventions attributed to the Phœnicians by Greek authors, the Minoans of Crete were the real pioneers.

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FRIDAY, SEPTEMBER 25, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

INTERNATIONAL FIRE EXHIBITION.

The Committee of this Exhibition have invited a party of the members of the Society of Arts to visit the Exhibition at Earl's Court on Wednesday, October 14th (afternoon and evening), and inspect the exhibits, including those to which the Society of Arts medals will have been awarded.

The members accepting the invitation will also have an opportunity of seeing the historical pageant and modern fire service display known as "Fighting the Flames."

The members will assemble at 4 p.m. inside the Warwick-road entrance of the Earl's Court Exhibition.

A round of the exhibits will be made in three parties, and the exhibitors will be requested to be in attendance at their exhibits to explain or demonstrate their appliances or work.

Modern fire appliances will be demonstrated at the lake from 5 to 6 p.m. (long ladders from 5 to 5.30 p.m. and fire engines from 5.30 to 6 p.m.).

The three parties will start to view the exhibits respectively as follows:—

Party "A."—Ducal Hall, 4.5 p.m., going by way of Queen's Palace, to Imperial Court.

Party "B" will start viewing in Imperial Court, at 4.10, visiting the Lake, Queen's Palace, and end at Ducal Hall.

Party "C" will commence in the Queen's Palace, 4.10 p.m., visiting the Lake, Ducal Hall, and ending at the Imperial Court.

The London Salvage Corps, by kind permission of Lieut.-Col. Fox, will turn out and drill in the Western Gardens at 6.30 and at 7.30 p.m.

The demonstration in the Empress Theatre will commence at 8.30 p.m. sharp.

The number of the party will be limited to 200. Not more than two tickets can be issued to any one member. They will be issued in order of priority of application. Members desiring to avail themselves of the invitation should apply at once to the Secretary of the Society, stating whether one or two tickets will be required.

In all cases admission to the theatre will be provided as well as admission to the Exhibition.

SECTIONAL COMMITTEE.

The following is the list of the Colonial Section Committee as appointed by the Council:—

COLONIAL SECTION COMMITTEE.

Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S. (Chairman of the Council).
Sir Westby B. Perceval, K.C.M.G. (Chairman of the Committee).
Earl of Aberdeen, G.C.M.G.
Lord Belhaven and Stenton.
Lord Brassey, K.C.B.
Hon. Sir John A. Cockburn, K.C.M.G.
Hon. Henry Copeland, Agent-General for New South Wales.
H. Bertram Cox, C.B.
Edward Dent.
Rt. Hon. Sir Charles Wentworth Dilke, Bart., M.P.
Hon. Alfred Dobson, Agent-General for Tasmania.
Hon. Sir Charles W. Fremantle, K.C.B.
Hon. Thomas E. Fuller, C.M.G., Agent-General for the Cape of Good Hope.
Sir Thomas Fowell Buxton, Bart., G.C.M.G.
Sir Robert Giffen, K.C.B., LL.D., F.R.S.
Right Hon. Sir George Goldie, K.C.M.G., D.C.L., LL.D.
J. G. Gordon.
H. Allerdale Grainger, Agent-General for South Australia.
Robert Kaye Gray.
W. L. Griffith.
Sir John J. Grinlinton.
Major General Sir William Henry Rhodes Green, K.C.S.I., C.B.
Sir Charles Hartley, K.C.M.G.
Hon. Sir Robert G. W. Herbert, G.C.B., D.C.L., LL.D.
Sir Clement Ll. Hill, K.C.M.G., C.B.
Sir Alfred L. Jones, K.C.M.G.
Sir Chas. Malcolm Kennedy, K.C.M.G., C.B.
Hon. Henry Bruce Lefroy, Agent-General for Western Australia.
Sir Nevile Lubbock, K.C.M.G. Chairman of the West India Committee.
Charles Prestwood Lucas, C.B.
Admiral Sir Erasmus Ommanney, K.C.B., F.R.S.
Sir Montague F. Ommanney, K.C.M.G.
Sir E. Montague Nelson, K.C.M.G.
Sir Walter Peace, K.C.M.G., Agent-General for Natal.
Hon. W. Pember Reeves, Agent-General for New Zealand.
Alexander Siemens.
Sir John Smalman Smith, M.A.
Earl of Stamford.
Lord Strathcona and Mount Royal, G.C.M.G., LL.D., High Commissioner for the Dominion of Canada.
Sir Thomas Sutherland, G.C.M.G.
Hon. Sir David Tennant, K.C.M.G.
Hon. Sir Horace Tozer, K.C.M.G., Agent-General for Queensland.
Sir Charles Rivers Wilson, G.C.M.G., C.B.
Sir John Wolfe-Barry, K.C.B., F.R.S.
Sir James Arundell Youl, K.C.M.G.
Sir Frederick Young, K.C.M.G.
S. Digby (Secretary).

Proceedings of the Society.

CANTOR LECTURES.

PAPER MANUFACTURE.

By Julius Hübner, F.C.S.

(Director of the Dyeing, Printing, and Paper-making Department, at the Municipal School of Technology, Manchester.)

Lecture III.—Delivered February 16th, 1903.

Beating — Sizing — Loading — Colouring — Stuff chest—Regulator—Sand tables—Strainer—Hand-made paper.

The treatment of the rags or other raw materials has now been considered up to the stage at which the half-stuff enters the potcher or the steeping chest. The half-stuff still contains fibre bundles, and further, the fibres are not present in lengths convenient for the manufacture of the various classes of paper. The final treatment which the half-stuff has to undergo, as also various auxiliary processes such as the loading, the dyeing, and the sizing, are conducted in the "beater." The operation of beating forms one of the most important links in the chain of processes constituting the manufacture of paper through which the fibres have to pass, and is one which largely influences the properties of the finished product. Prior to the invention and introduction of the Hollander, rags were disintegrated in the so-called stamping or hammer-mill; the process of disintegration as carried on in this apparatus being accomplished either by hammering or squeezing the pulp, it resulted in the splitting up of the filaments into single fibres and in a further disintegration of the single fibres, by splitting them lengthways, into fibrillæ.

The action of the Hollander roll, though similar, is, however, not the same as this, for in addition to the squeezing or breaking, a cutting or tearing of the fibres, mostly crossways, also takes place. Micro-photographs of papers which were made before and after the introduction of the Hollander show quite plainly the difference in the fibrous structure. The beating is necessarily varied according to the nature of the fibrous material and according to the properties desired in the finished paper.

Long fibres, such for instance as those of flax and cotton, require breaking and brushing, that is, splitting into fibrillæ, whilst short fibres, such as those of straw, esparto, &c., simply require separating without further disintegration. Cutting of the fibres should, however, in any case be avoided as far as practicable. These considerations lead to the conclusion that it is inadvisable to treat fibres possessing widely different structures at the same time in the beater.

The beating engine (Fig. 12), is similar in construction to the breaker, but variations are frequently made in the number and in the arrangement of the knives in the roll and in the bed plate. To avoid the injurious action of iron in the manufacture of certain classes of papers, such as photographic papers, &c., the knives should be made of either bronze or gun-metal.

Beater rolls made of stone have also been used, and quite recently Schmidt patented a roll and bedplate made of a special kind of basalt-lava, into which the knives are cut. Owing to the porous nature of the lava, the beating surface is considerably increased and the time of beating correspondingly reduced.

The time occupied by the beating varies very considerably according to the structure of the fibres and to the result required; if it is desired to preserve the fibrous nature of the pulp, it is necessary to extend the beating over as long a time as possible and to use blunt knives, both in the roll and in the bed plate. Some beaters are provided with stuff propellors—a kind of paddle-wheel—to accelerate the circulation of the pulp.

Considerable attention has been paid by engineers to the construction of modern beaters, the objects being the saving of time and of power, and in order to achieve these ends engines have been constructed with two and even more beater rolls.

Apart from the beating, the circulation of the pulp in the Hollander has to be maintained by the roll, and a considerable amount of power is thus consumed quite apart from that expended in the actual beating. The credit of designing a beater in which the roll is exclusively used for the beating is due to the engineers Debiè, Granger, and Pasquier; a roll of considerably smaller diameter and less weight, placed above the level of the pulp, is used in this beater, whilst the circulation of the pulp is produced by means of a large paddle-wheel placed immediately in front of the roll. A considerable number of patents have been taken for beaters similar in principle

to the one just mentioned, but more or less improved upon in details of construction.

The question of saving space has also occupied the inventive mind. Thus, for instance, we find in Forbes' beater two rolls in trough, has been also devised by Debié, Granger, and Pasquier. In the Umpherston beater the circulation of the pulp through a channel underneath the back-fall, is caused by the roll. To ensure rapid circulation of the

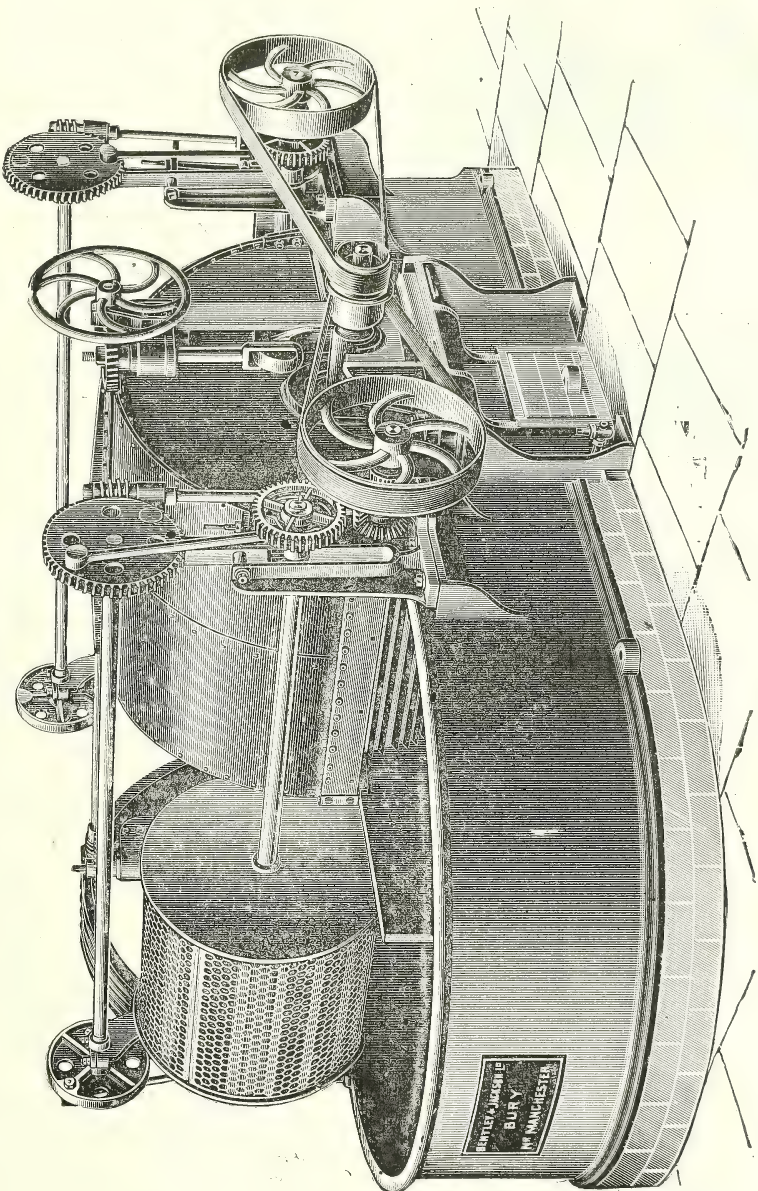


Fig. 12.

two outer channels for which only one central channel is provided. The circulation of the pulp is assisted by means of a paddle-wheel. Another beater, in which the pulp returns to the roll through a channel underneath the pulp provision is made in the shape of screw propellers, in some types of modern beaters, such as the "Taylor," the "Reed," the "Hemmer," the "Bertram-Shand," and others.

Fig. 13 shows a Hemmer underflow beating engine in elevation, whilst Figs. 14, 15, 16, and 17 show the working parts, such as the roll, *a*,

FIG. 13.

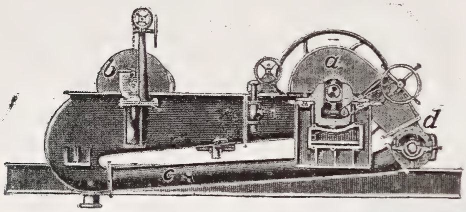


FIG. 14.

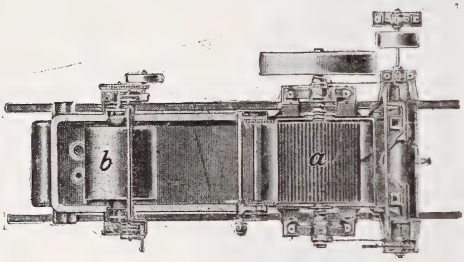


FIG. 15.

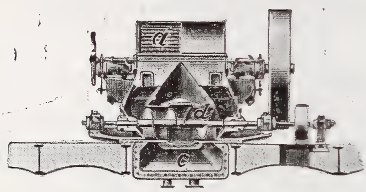


FIG. 16.

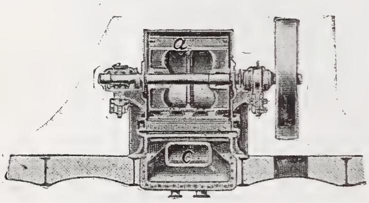
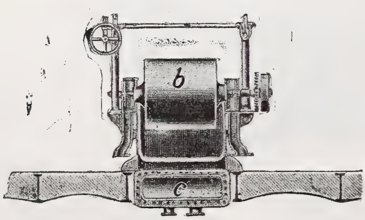


FIG. 17.

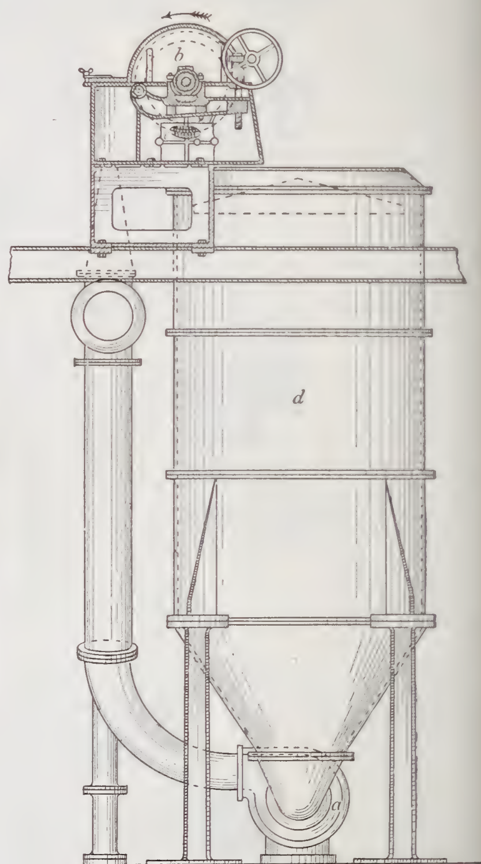


the drumwasher, *b*, the channel, *c*, and the propeller *d*.

The Tower beating engine (Fig. 18), patented by Messrs. Masson, Scott and Co., Ltd., is another modern beater in which the stuff is circulated by means of a patent circulator, *a*, and, after having been acted upon by the knives in the roll, *b*, and the knives in the bed-plate, *c*, is spread by means of a conical top to the tower, *d*, entering it at the circumference. It is then again drawn from the tower from the centre into the circulator and conveyed to the beating engine.

The final beating or brushing of the fibres is conveniently accomplished in the so-called

FIG. 18.



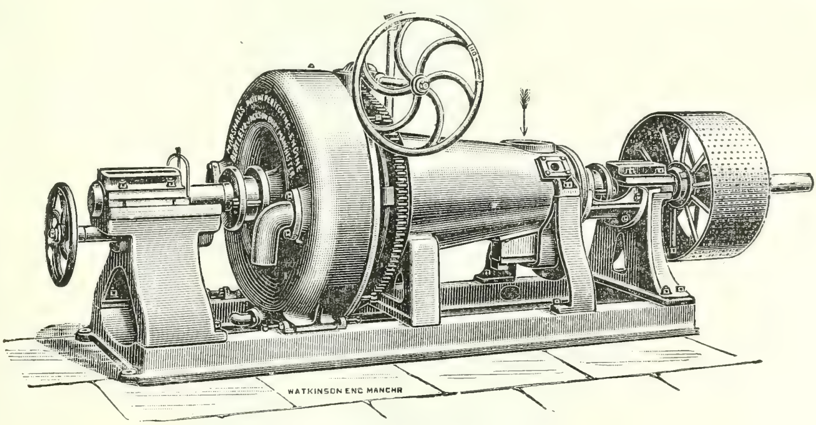
"refining engine," a machine of American origin; the names associated with the invention of these engines are those of Kingsland, Jordan and Eustice, Gould and Marshall. The type which is used very extensively in this country is the Marshall pulp refiner of Messrs. Bentley and Jackson, Limited (Fig. 19 and 20), which consists of two cones, a larger stationary A[1], and a smaller revolving one A, both provided with beater knives. The smaller is placed inside the larger cone and thus the pulp, during its passage between the

two, is acted upon by the knives. Before leaving this engine, the fibres have to pass between the knives fixed on a revolving disc, B, and the knives, B[1], on the inside of the chamber in which this disc is enclosed.

Considerable experience is required to judge whether a pulp has been sufficiently beaten. It is the practice to take a small quantity of the pulp out of the beater and to reduce it with water in a small hand bowl; by this means the degree of disintegration of the fibres may be readily ascertained.

In the production of high-class papers and in the dyeing of delicate shades it is of the greatest importance to employ water of great purity, especially in the beating.

Fig. 19.



Antichlor.

Although the removal of bleach and of other impurities formed during the bleaching operation is most completely effected by subsequent washing, it is, in many instances not found possible to carry the washing far enough. Recourse has therefore to be made to decomposition by means of the so-called "antichlors"; the chemical agents mostly in use for this purpose are sodium thiosulphate and sodium sulphite.

With calcium hypochlorite, the first of these salts forms sodium sulphate and calcium chloride, whilst the second one gives calcium sulphate, sodium sulphate, and sodium chloride. On account of the injurious action of the free hydrochloric acid which is formed by double decomposition when thiosulphate is used as antichlor, sodium sulphite has found by far the widest application. Though an excess of antichlor is frequently considered harmless, it may exert an injurious action on size and colouring matters. It is therefore obvious that the quantity added should never exceed the amount required for the decomposition of the bleach present. Hypochlorite in the pulp may be readily detected by means of potassium-iodide-starch paper, which developes a characteristic blue colouration with free chlorine.

Sizing.

The sizing of the pulp is the next of the operations conducted in the beater, which calls for consideration. Paper made from fibres in a pure state, as produced in the beating engine, will not resist water or ink; the pores and the canals in the fibres on the one hand, and the interstices between the fibres in the sheet of paper, on the other hand, absorb liquids very rapidly by capillary attraction. The object of sizing is to fill up the pores and the interstices and thus to make the paper, to a certain extent, ink and water resisting. Wiesner has ascertained that starch was used for the sizing of papers, in very early times, whilst, at a later period glue was employed for surface sizing.

In engine sizing—so called because it is conducted in the beating engine—finely divided rosin is precipitated in the paper pulp. Illig, who invented this method of sizing at the beginning of the last century, recognised that its efficacy is due to the precipitation of free rosin in a state of very minute division; Wurster, Conradin, and Lunge have shown that Illig's view was quite correct.

The "rosin size," or "rosin soap," as it is termed, is prepared by dissolving rosin in soda in a double-jacketed pan which is heated by

steam. If the quantities used are in molecular proportion, the soap produced is of a brownish colour and syrupy appearance and is called brown or "neutral" rosin size. It should be

water, free rosin is precipitated in a very finely divided state. During late years a tendency has been developed to prepare a size containing as large a quantity of free rosin as possible,

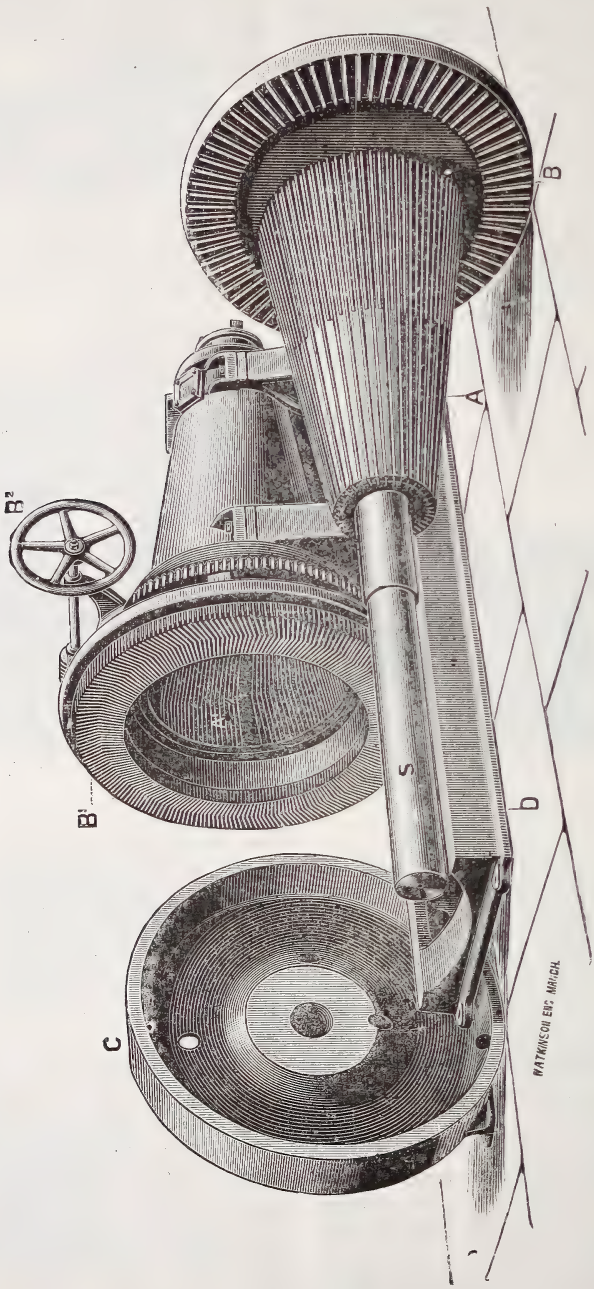


Fig. 20.

perfectly soluble in water. This soap possesses the power of dissolving further quantities of rosin (15 to 25 per cent.) in a free state.

A size of this description is called white or "acid" rosin size, and on diluting it with

with the result, that rosin size is now prepared under high pressure in specially constructed vessels. (Arledter size.)

Rosin size, obtained by either of the methods described, is generally used in conjunction with

starch, especially in the manufacture of high class papers and of papers which have to be heavily loaded. The size should be diluted with water before being added to the beater; after the addition, sufficient time is allowed for it to mix completely with the pulp and the size is decomposed by means of alum or aluminium sulphate. Free rosin is precipitated and basic aluminium sulphate remains in solution; rosin is also precipitated if sulphuric acid is used instead of alum, as has been done by Conradin and others for sizing papers.

The amount of alum or aluminium sulphate added is invariably in excess of the equivalent required for the decomposition of the quantity of rosin soap used.

Various agents have been proposed as substitutes for rosin size. Of these "viscose" (cellulose sulpho-carbonates) calls for special attention. The preparation of this cellulose compound, which is soluble in water, has been described in the first lecture. The necessary quantity of viscose is added to the pulp and allowed to become thoroughly mixed; the decomposing salt, either magnesium sulphate or zinc sulphate, is then added, and gelatinous cellulose is precipitated which acts as a strong sizing agent. In most instances it is found necessary to add a small quantity of rosin size. Papers which have been sized with viscose show a remarkable increase in tensile strength, but the slight discoloration, due to decomposition products of viscose, has up to the present time prevented its being used for the sizing of white papers.

Casein, prepared from milk, is another sizing agent which may be added in solution to the pulp, and which is readily precipitated by alum. Casein, although excellently suited for paper sizing, is but little used on account of its cost. Other sizing agents, such as silicate of soda, aluminate of soda, ammonium albumen, wax, paraffin, &c., are very rarely used.

Loading.

Mineral substances are often added to the paper pulp whilst in the beating engine; this operation is known as "loading" or "filling." One of the objects of the addition of loading materials is the cheapening of production by the substitution of fibres by a cheaper mineral substance; in many instances, however, the addition of loading materials is, for other reasons indispensable. Certain mineral colours used in paper dyeing act at the same time also as loading materials; to produce uniformity of shade in the dyeing of pulp which consists of a mixture of different fibres, the introduction of a suitable loading material may be found necessary. Loading also helps to make a paper less transparent, and the smoother surface produced in finishing is better adapted to the requirements of printing. In choosing a loading material two points have to be borne in mind, namely, the properties of the paper for which it is to be used, and the cost of the material itself. The latter point will, to a very large extent, depend upon how much of the material in question is actually carried by the pulp.

China clay (kaolin), which consists essentially of aluminium silicate, is the most commonly used loading material.

Pearl hardening (sulphate of lime), imparts a very superior finish to papers and is therefore employed in the manufacture of high-class papers. Its use is, however, rather costly, owing to its solubility in water.

Heavy spar, blanc fix (barium sulphate), is one of the most useful loading materials, giving the paper very valuable properties. It may be added either in form of a paste, or better, it may be precipitated in the pulp by decomposing barium chloride with Glauber's salt.

Agalite, which consists essentially of magnesium silicate, possesses a fibrous structure similar to that of asbestos. It imparts a soapy feel to papers and gives an excellent finish. Owing to its fibrous structure nearly the whole amount of this material added is carried by the pulp.

Starch. — As already mentioned under sizing, starch is frequently used together with the rosin soap; it is, however, quite safe to count it among the loading materials. A large portion of the starch added to the pulp is lost; but, although expensive, its use for high-class papers cannot be dispensed with.

The feel of papers loaded with starch is not unlike that of tub-sized papers; they do, not, however, possess the characteristic water-resisting properties of the latter.

Colouring.

The last process which is conducted in the beater consists in dyeing the paper in the pulp. The paper fibres, being nearly exclusively of vegetable origin, show much less affinity towards colouring matters than do the animal fibres, wool and silk. On account of the minute state of division of the fibres in the pulp, colours are, however, generally speaking, much more readily taken up than

is the case in the dyeing of the same fibres in the form of yarn or cloth.

The affinity of the various fibres towards colouring matters differs considerably, a factor to be taken into consideration in the manufacture of coloured paper which consist of a mixture of various kinds of fibres. To secure a level appearance of the surface of papers of this description, mineral loading materials or mechanical wood pulp are added, the contrast of shade being thus considerably reduced. The colouring matters used in the dyeing of paper pulp may be conveniently divided into two groups, namely, the substantive, and the adjective colours. The former dye fibres direct, that is without the application of a mordant, whilst, when the latter are used a previous mordanting of the fibres is necessary to ensure fixation.

In the manufacture of cheap coloured papers, the rosin size added to the pulp may be considered as the natural mordant for many colours. The finely divided rosin, which surrounds the fibres, acts in these instances as a fixing agent.

The mordants most commonly used in paper dyeing are alum and aluminium sulphate. Their application is very simple, and they possess a remarkable affinity towards many colouring matters. Iron salts, such as ferrous sulphate, nitrate of iron, and acetate of iron are used in the dyeing of greys, blacks, and other dark shades and in the manufacture of Prussian blue, a colour very much in demand for paper dyeing.

Tannic acid is a very valuable mordant; with iron mordants it produces useful greys, which may be conveniently used as a bottom for other colours. Tannic acid, employed either by itself or neutralised, or precipitated with tartar emetic, is the best fixing agent for the basic aniline colours, such as magenta, methylene blue, &c.

The principal colouring matters which are used in the dyeing of paper pulp may now be briefly reviewed, classifying them for this purpose into "inorganic" and "organic colours." Of the former class, the natural mineral colours also called earth colours, are still very extensively used on account of their cheapness and their property of acting both as colouring and loading materials. The various brands of iron ochre, the oxide red, caput mortuum, umber, sepia, green earth, mineral black, China clay and pearl hardening, are amongst the principal representatives of this class.

The artificial mineral colours may either be prepared outside the beater and then added to the pulp, or the precipitation of some of these colours may be actually effected in the beater. Wherever convenient preference should be given to the latter method, the precipitation of the colour as well as the fixing being partly accomplished in the fibres.

Some of the most important paper colours belong to this group, the principal representatives of which are—iron buff, manganese bronze, chrome yellow and orange, Prussian blue, ultramarine and smalts.

The other group of colours with which we have to deal next are the organic colours. They may be sub-divided into "natural organic colours," that is colours of vegetable and animal origin, and "artificial colouring matters" usually called "coal tar colours." Many of the colours belonging to the former group have been superseded by the artificial products which are more easily appplied and which may be obtained in a more concentrated form.

Of the natural organic colours, annatto, turmeric, safflower, red wood, cochineal, weld, and others, are now, practically speaking, of historical interest only. Amongst such colours as are still extensively used, are logwood, and in combination with it, fustic extract, for cheap blacks and greys; also catechu or cutch for fast browns or as a bottom or a mordant for dyeing heavy shades with aniline colours.

The artificial organic colouring matters now at the disposal of the paper-maker are very numerous. Their characteristics are brilliancy and purity of shade, strength, easy application, and solubility in water. Fastness to light and air is, however, with few exceptions, not their strong point.

Time will only permit me to mention the chief representatives of the various classes. Of the yellows and oranges we have auramine, metanil yellow, naphthol yellow, orange II. and chrysoidine; of the browns—Bismarck brown and vesuvine; of the blues—water blue, Victoria blue, and methylene blue; of the reds—the eosines, rhodamines, palatine scarlet, saffranine, and magenta; of the violets—methyl violet and crystal violet; of the greens—brilliant green and malachite green; and of the greys—the nigrosines.

The application of colours to the pulp is, however, not restricted to coloured papers. Nearly all whites have to be produced by adding small quantities of colours. The natural shade of the bleached pulp is counteracted by a

complementary colour and thus the impression of white is presented to the eye; this process is known as "tinting" of papers.

After bleaching and dyeing the pulp is ready to be conducted to that part of the mill in which its conversion into paper actually takes place.

From the beater it is allowed to flow into the stuff chest (*a*, Figs. 21 and 22), a large vessel made of wood or built in bricks and cement, provided with either a vertical or a horizontal stirring arrangement. The quantity of pulp which comes from the stuff chest and which is required to produce a paper of certain thickness and at a certain speed has to be carefully regulated. To achieve this the pulp is generally first pumped to the so-called "regulating box," from which a continuous stream under a constant pressure is conducted to the paper machine.

Another arrangement in very common use, especially in Continental mills, has been devised for regulating the flow of pulp from the chest to the sand tables and is the following:—The horizontal stirring arrangement in the stuff chest is provided at one end with a circular rim which carries on its circumference a series of small beakers or buckets. During their downward journey these beakers are filled by tipping into the pulp. On reaching the highest position the pulp is discharged into a channel connected with the sand tables; this channel may be widened or narrowed according to the amount of pulp required, the excess of pulp flowing back into the stuff chest.

Special pulp regulators, consisting of two or three pumps, as well as arrangements in which the flow of pulp is regulated directly from, and in accordance with, the speed of the paper machine, are used in some mills.

In the manufacture of heavily-sized, loaded and coloured papers, it is essential to the production of uniformity of shade and quality to use the so-called "back water" for the thinning down of the pulp in place of fresh water. The mixing is usually accomplished in a small mixing chest placed above the level of the sand tables to which pulp and back water are conducted; the pulp then travels over the "sand tables" (*b*, Figs. 21 and 22), which consist of shallow troughs varying in length considerably according to the quality of paper made on the machine. Ribs are fixed cross-ways on the bottom of these troughs and during their passage over the sand tables heavy particles, such as sand, contained in the pulp as impurities, settle behind these ribs.

The pulp still contains fibre bundles which have escaped the action of the knives and also small knots consisting of felted fibres, as well as other impurities, which, if allowed to pass along to the paper machine would show as "specks." To free the pulp, as far as possible, from these impurities, it is necessary to pass it through one or more "strainers," *c* (Figs. 21 and 22). The operation of "straining" is accomplished by the aid of brass plates provided with very fine V-shaped slits which are narrower at the top and are wider towards the other side of the plate. These slits which vary in width for the different qualities of pulp are, however, only just wide enough to allow the single fibres to pass through whilst all the coarser particles are retained on the top of the plate. A number of these plates securely bolted together form a strainer. By means of rapidly revolving ratched wheels, which support the axle of the strainer, a shaking motion is produced which greatly assists the passage of the pulp through the slits. A strainer in which the plates are bolted together so as to form a flat surface is called a "flat strainer." The other types in which the plates form a rectangular box or a slowly revolving cylinder, are termed "revolving strainers."

Flat strainers have been introduced in which the passage of the pulp is considerably accelerated by a vacuum produced underneath the strainer plate.

Automatic cleansing devices, consisting of endless bands provided with india-rubber scrapers or brushes which move over the surface of the plates and carry away the knots, are also in use with flat strainers. In other self-cleansing strainers the knots are carried along with the pulp into channels from which they are conducted to "patent knotters."

The rotating strainer invented by Wandel (Fig. 23), consists of a revolving cylinder (*a*) placed horizontally in a trough; this cylinder is formed of a number of plates bolted securely together the narrower parts of the slits being on the inside. The pulp enters through the hollow journals (*b*), and finds its way through the slits into the trough, whilst knots and other impurities are lifted by ribs between the plates inside the cylinder whence they ultimately fall into, and are conducted away through, a channel (*c*) situated above the channel through which the pulp enters. A spurt pipe (*d*) fixed above the cylinder directs

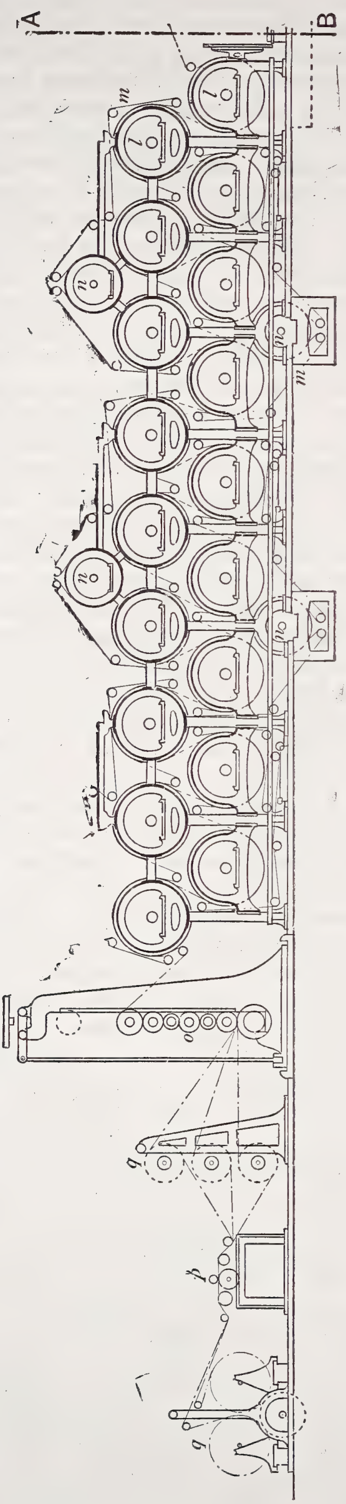


FIG. 21.

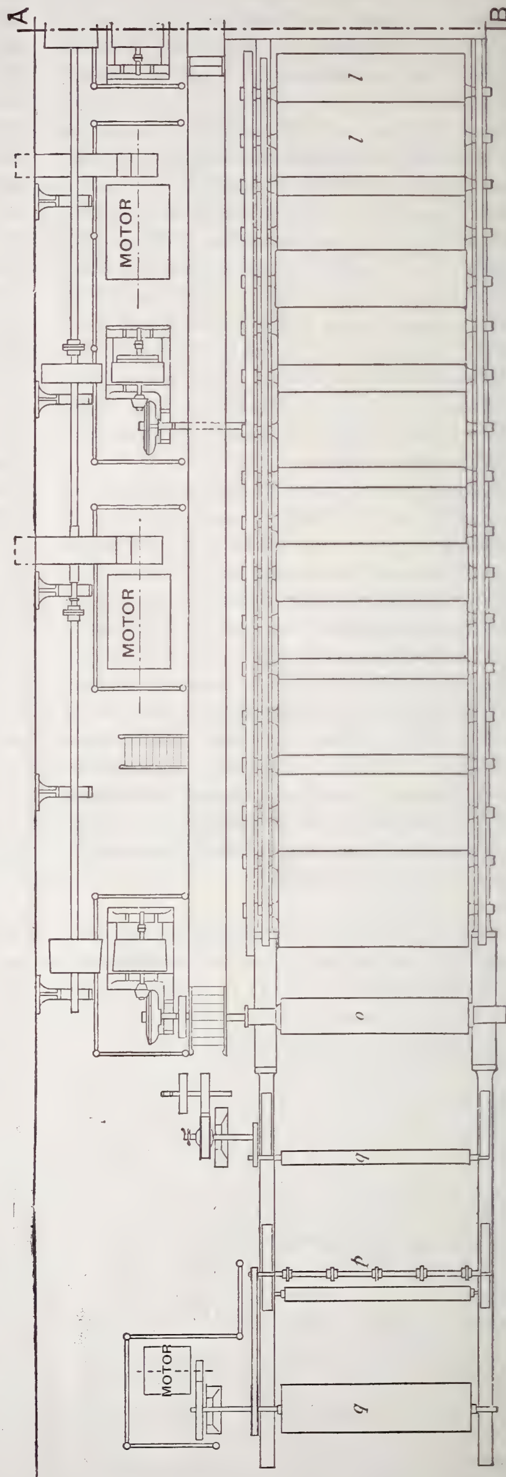


FIG. 22.

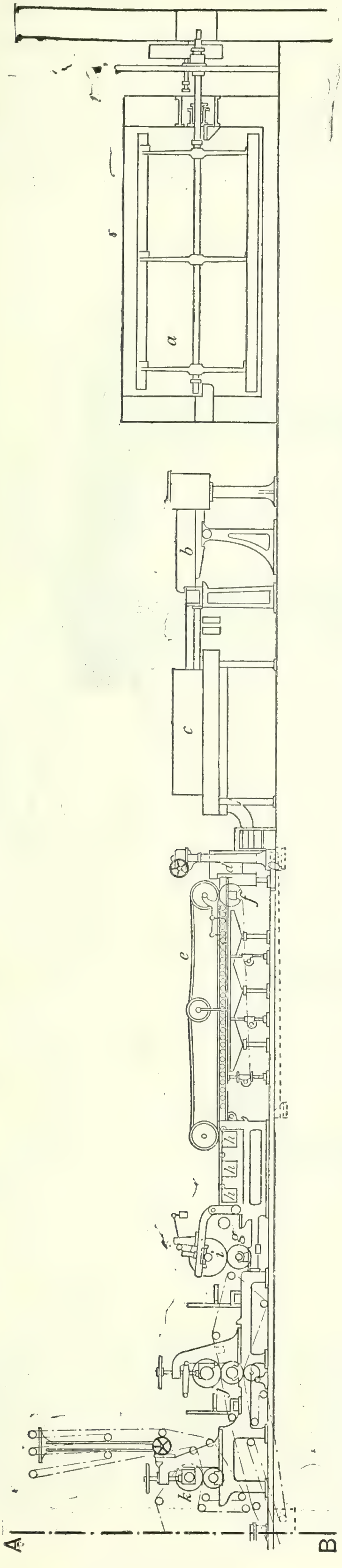


FIG. 21.

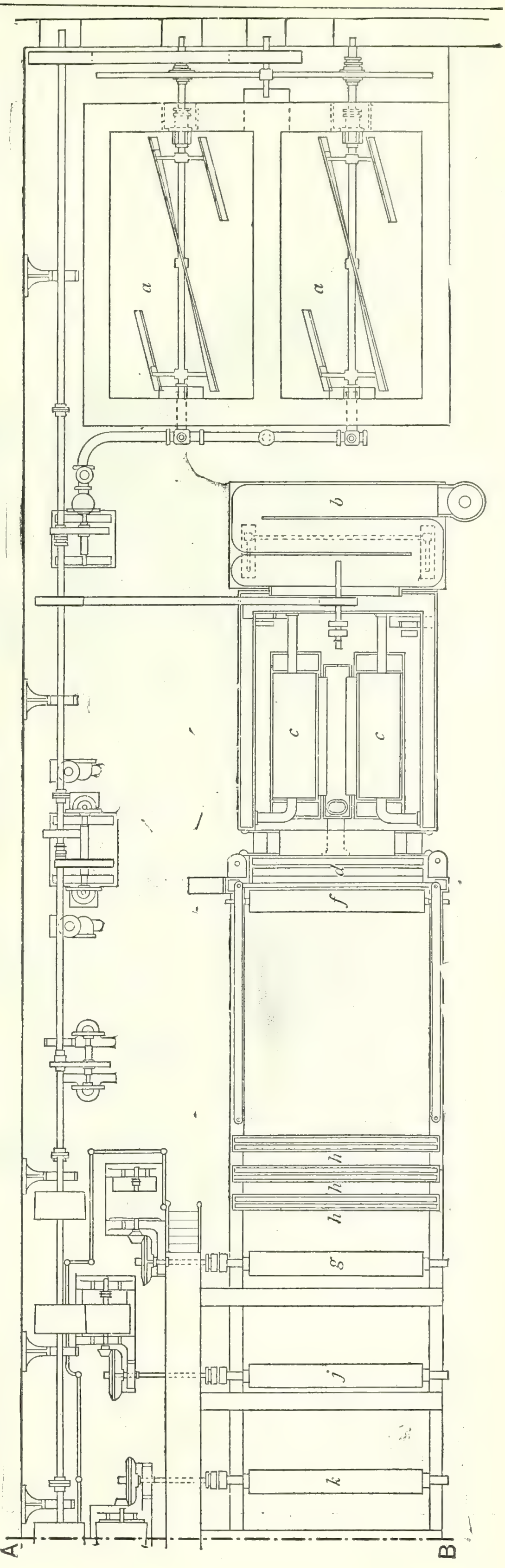
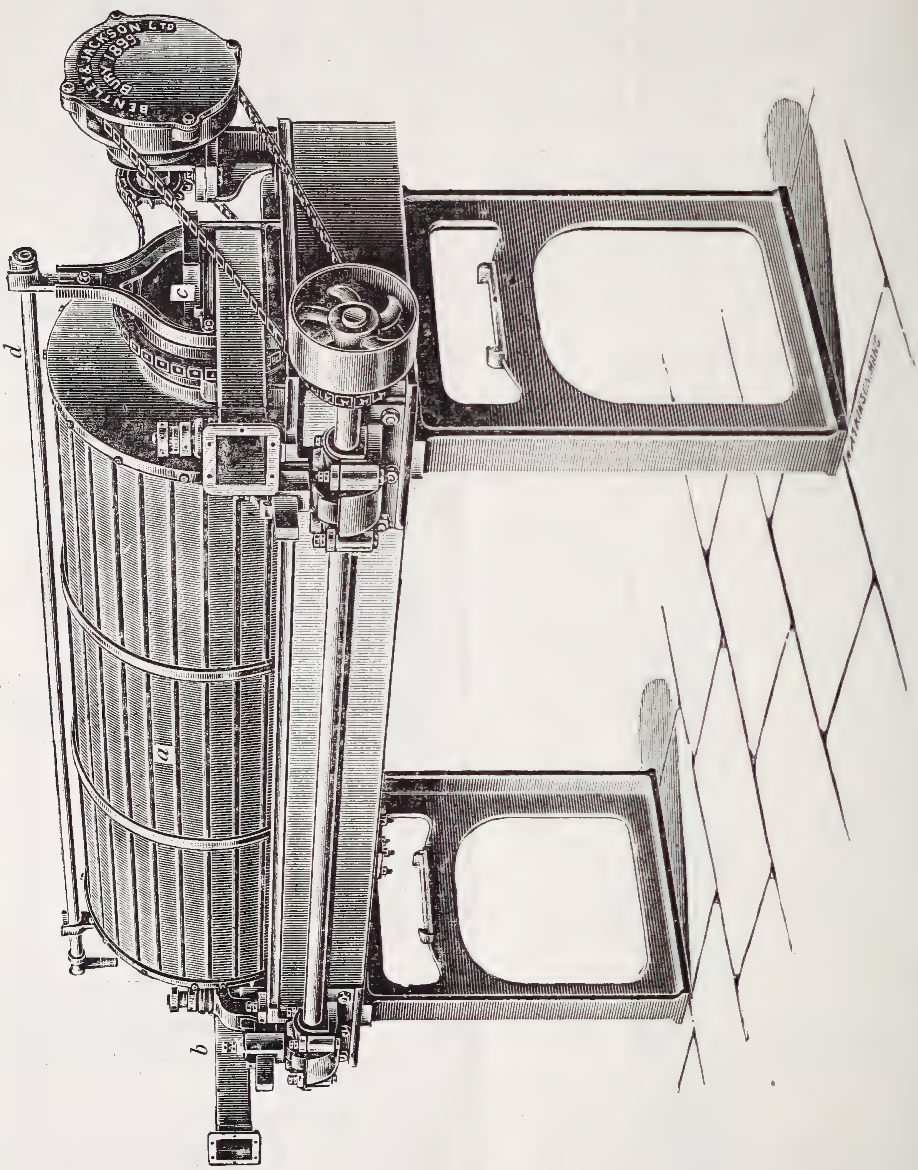


FIG. 22.

a stream of fresh water against the plates, thus preventing choking of the slits.

After its passage through the strainers the pulp is ready for conversion into paper. Up to this point the series of processes through which pass the raw materials both for paper made by hand and by machine, are identical, with the sole exception of the sizing of the pulp in the engine. We may therefore at this stage conveniently consider the older of the two methods of making paper, namely, the so-called "hand process." The pulp, as it leaves the strainer, is conducted to a box containing a small drumwasher, by aid of which water is removed and unnecessary dilution of the stuff in the vat avoided. From this the pulp flows in a continuous stream into the vat, which is a rectangular vessel usually made of hard wood; settling of the fibres in

FIG. 23.



the vat is prevented by the use of a stirring arrangement and a uniform temperature is maintained by means of a steam-heated closed coil. The sheet of paper is actually made upon an appliance called the "mould;" the mould consists of two parts, the framework, made of wood, over which is evenly stretched

a piece of fine wire gauze supported by coarser wires, and the "deckle," a narrow frame which fits closely on to the top of the wire gauze screen. The deckle serves the purpose of preventing the pulp from flowing away over the sides of the mould; the amount of pulp removed from the vat, and therefore the thickness of the finished paper, are, to a certain extent, determined by the height of the deckle.

The workman who handles the mould is called "the vatman"; he takes from the vat the quantity of pulp required to form a sheet of paper by dipping the mould into the pulp and lifting it out whilst holding it horizontally. As the water passes away through the sieve the vatman gives the mould a peculiar shaking motion by means of which felting or intertwining of the fibres is ensured; the strength of the resulting paper depends to a very considerable extent upon the skill with which this part of the process is performed.

As soon as the water has drained sufficiently the mould is passed by the vatman to the "coucher," who, after the deckle has been removed, presses the wet sheet on to a felt. The mould is then removed and the sheet of paper covered with another felt. Paper and felts are thus placed carefully alternately one on the other until a so-called "felt post" has been obtained; this is then removed to a press by means of which a large portion of the water is slowly pressed out. The sheets having obtained sufficient strength by the treatment are separated from the felts and placed one on the top of the other and are once more taken to the presses; the felt marks are thus removed and the surface of the paper is considerably improved.

In the case of some papers this pressing is repeated, the sheets being separated and again placed in contact between each operation. The pressed papers are next conveyed to the drying-room where they are placed on ropes, usually made of cow-hair, and slowly dried. A mould, the covering gauze of which consists of wires of uniform thickness placed at equal distances lengthways and crossways, is called a "wove mould." If the wires are arranged closely together in the one direction but are placed further apart in the other direction, the mould is termed a "laid mould." Papers made on the two kinds of moulds are called "wove" and "laid" papers respectively. Water-marks are produced by wires sewn on the top of the wire on the mould. The paper is thinner and therefore more transparent at these parts, owing to fewer fibres having been deposited. By using wires of varying thickness, and also by sewing on to the mould patterns produced by pressing very flexible wire gauze between steel dies, most elaborate water-marks may be produced.

No size having been used with the pulp, the sheets, as they come from the drying-rooms, are absorbent, and therefore unsuited for writing and for some printing purposes; the next operation through which hand-made paper has to pass is the so-called "tub sizing," and is accomplished by passing the sheets through a solution of glue or gelatine. This is generally done by hand, although some mills are provided with special sizing machines in which the sheets travel through the size on endless bands.

The glue, as used in the tub sizing, is either prepared in the mill by treating clippings of hides, bones, horn, &c., with water, thus extracting the gelatine; or very pure gelatine, which dissolves readily in water, is bought and used by the paper-maker. A certain amount of alum is always added to the gelatine solution in the manufacture of highly-finished papers and soap is frequently used in conjunction with the tub size.

The sheets are freed from excess of size by pressing in screw or hydraulic presses; they are then separated and conveyed to the drying chamber for the final drying. Hand-made papers are finished either by repeated pressing in hydraulic presses, by calendering, or by plate glazing.

Miscellaneous.

*MOTORS.**

Speed in locomotion appeared to be the first consideration, whether as regards mails, passengers, or goods; and three or four classes of machines appeared to be ambitious to drive pedestrians, horsemen, and horse-drawn vehicles off the road. The first practical steam carriage was used by Trevithick in the year 1802. The points of importance in connection with traction engines and their trailers are their speed, weight, and width. Mr. E. R. Calthrop, M.Inst.C.E., one of the founders of the Liverpool Self-propelled Traffic Association, was opposed to any weight restriction, but it was to be remembered that the momentum of heavily laden waggons drawn by a powerful traction engine at the maximum speed

* Extracted from the Presidential Address by Mr. Charles Hawksley to the Engineering Section of the British Association at Southport.

of five miles an hour, was very great, and caused uncomfortable vibration in the houses along main thoroughfares; on the other hand, light traction engines were being successfully used, drawing from four to five tons of market produce through the streets of London without causing undue vibration, and at a cost said to be about one-half that of horse traction. A far more burning question was that of the speed of motor-cars along our public thoroughfares. The struggle to maintain a trophy at home, or to regain it from abroad, was one in which every inhabitant of this country sympathised. The great Gordon-Bennett Cup race in July last was decidedly international in character—French, Germans, Americans, and English contesting for the prize. M. Jenatzy covered a distance of $327\frac{1}{2}$ miles in six hours 39 minutes, or at the rate of $49\frac{1}{4}$ miles an hour, though he attained to a speed of 61 miles an hour between the points of control. Even this speed was exceeded at a trial in Phœnix-park, Dublin, when Baron de Forest attained to a rate of 86 miles an hour. But between racing speed and ordinary travelling speed there is necessarily a great difference, and our 20 miles maximum on country roads is in excess of that allowed in France, where it is now fixed, though the author believed not enforced in the open country, at $18\frac{1}{2}$ miles, and at $12\frac{1}{2}$ miles where there was much traffic. The use of motor-driven vehicles for road traffic was so intimately associated with improvements in prime movers that it would interest the members of the section to be reminded of the opinion expressed more than 20 years ago by Sir Frederick Bramwell, who presided over the meeting of the British Association, at Bath, in 1888. In a paper read at the Jubilee meeting of the Association, at York in 1881, Sir Frederick Bramwell said:—"However much the Mechanical Section of the British Association may to-day contemplate with regret even the mere distant prospect of the steam-engine becoming a thing of the past, I very much doubt whether those who meet here fifty years hence will then speak of that motor except in the character of a curiosity to be found in a museum." To keep alive the interest of the Association in this subject, Sir Frederick Bramwell had kindly offered, and the council had accepted, the sum of £50 for investment in $2\frac{1}{2}$ per cent. self-accumulative Consols, the resulting sum to be paid as an honorarium to a gentleman to be selected by the council to prepare a paper having Sir Frederick's utterances in 1881 as a sort of text, and dealing with the whole question of the prime movers of 1931, and especially with the then relation between steam-engines and internal-combustion engines. That paper would doubtless prove to be a very valuable contribution to the proceedings of the Association, and one could only regret that many of those assembled here to-day could not hope to be present when it was read, and to listen to an account of the nearest approach which had then been made towards the production of a perfect prime mover.

THE ORIGIN OF JEWELLERY.*

Personal ornaments in civilised countries consist o precious metals, stones, or imitations of stones, pearls (which are the product of shells), or shells themselves, amber, jet, and occasionally various other objects, such as tiger's claws, &c. It has hitherto been held that men and women were led by purely æsthetic considerations to adorn themselves with such objects; but a little research into the history of such ornaments leads to a very different conclusion. The fact is that mankind was led to wear such objects by magic rather than by æsthetic considerations. The jewellery of primitive peoples consists of small stones with natural perforations, *e.g.*, silicified spones or joints of coniferæ, or of substances easily perforated, such as amber, the seeds of plants, shells, the teeth and claws of animals, bones, or pieces of bone, pieces of wood of popular kinds. Later on they learn to bore hard stones, such as rock crystal, hematite, agate, garnet, &c., and to obtain the metals.

All peoples value for magical purposes small stones of peculiar form or colour long before they can wear them as ornaments; *e g.*, Australians and tribes of New Guinea use crystals for rain-making, although they cannot bore them, and crystal is a powerful amulet in Uganda fastened into leather. Sorcerers in Africa carry a small bag of pebbles as an important part of their equipment. So was it in Greece. The crystal was used to light sacrificial fire, and was so employed in the Church down to the fifteenth century. The Egyptians under the twelfth dynasty used it largely, piercing it along its axes after rubbing off the pyramidal points of the crystal, sometimes leaving the natural six sides, or else grinding it into a complete cylinder. From this bead came the artificial cylindrical beads made later by the Egyptians, from which modern cylindrical glass beads are descended.

The beryl, a natural hexagonal prism, lent itself still more readily to the same form, *e.g.*, the cylindrical beryl beads found in Rhodian tombs. The Babylonian cylinders found without any engraving on them on the wrists of the dead in early Babylonian graves had a similar origin. It has been universally held that Babylonian cylinders, Egyptian scarabs, and Mycenean gems were primarily signets; but as the cylinders are found unengraved, and as many as 500 scarabs are found on one mummy, and as Mycenean stones are often found without any engraving, it is clear that the primary use was not for signets but for amulets. The Orphic Lithica gives a clear account of the special virtue of each stone, and it is plain that they acted chiefly by sympathetic magic; *e.g.* green jasper and tree agates make the vegetation grow, &c. The Greeks and Asiatics used stones primarily as amulets, *e.g.* Mithridates had a whole cabinet of gems as antidotes to poison. To enhance the natural power of the stone a device was cut on it, *e.g.* the Abraxas

* Abstract of a paper read by Professor W. Ridgeway, before the Anthropological Section of the British Association, at Southport.

cut on a green jasper, the special amulet of the Gnostics. The use of the stone for sealing was simply secondary, and may have arisen first for sacred purposes.* Shells are worn as amulets by modern savages, *e.g.* cowries in Africa, where these or some other kind of shells were worn in Strabo's time to keep off the evil eye.

Red coral was a potent amulet worn by travellers by sea, as at the present day in Mediterranean lands, and if pounded up it kept red rust from corn. Pearls are a potent medicine in modern China. Seeds of plants are medicine everywhere; for example, the ratti (*Abrus precatoria*) is used in India for rosaries, and also in Africa; the seed of wild banana is especially valued in Uganda, &c. The claws of lions are worn as amulets all through Africa, and are "great medicine," and imitations of them are made. So with teeth of jackals, which are imitated in wood if the real ones are not to be had, and boars' tusks in New Guinea. When gold becomes first known it is regarded exactly like the stones mentioned. Thus the Debæ, an Arab tribe, who did not work gold, but had abundance in their land, used only the nuggets, stringing them for necklaces alternately with perforated stones.† Magnetic iron and hematite were especially prized, the power of attraction in magnetic iron, as in the case of amber, causing a belief that there was a living spirit within. Hence ron in general was regarded with peculiar veneration, and not because it was a newer metal, as is commonly stated.

It is thus clear that the use of all the objects still employed in modern jewellery has primarily arisen from the magical powers attributed to them, by which they were thought to protect the wearer.

* *Cf.* Herod. ii. 38.

† Strabo, p. 778.

AUSTRALIAN SPONGES.

Although the existence of various kinds of sponge on the Australian coast has been known for many years, the possibility of cultivating those descriptions possessing a commercial value has only recently attracted attention. It appears that in August, 1900, the trustees of the Australian Museum, in Sydney, received from the New South Wales Fisheries' Commissioners a donation of a large collection of sponges obtained by their inspectors stationed on the seaboard of the State, the object being to ascertain the number of species suitable for commercial purposes, or that might be rendered such by cultivation. The work of investigation was entrusted to Mr. Thomas Whitelegge, the Museum Zoologist, who devoted considerable time to the work of classifying the collection, consisting of about six hundred and thirty specimens, of which forty belonged to the commercial kinds, seven being regarded as possessing an economic value. The result was to show that at least eight species and varieties of sponge, having a commercial value, were indigenous to the New South Wales coast, and that it was probable a systematic investigation would prove the existence of other kinds of equal or superior commercial value Many of the specimens had been washed ashore during heavy gales, while others were waterworn or dried up. Several kinds were obtained from Sydney Harbour. The living sponge has been seldom met with, but during some fierce gales in 1901 the heavy seas cast on the harbour and ocean beaches an enormous amount of marine products. Seaweed was piled up to the depth of three or four feet, and with it a vast quantity of animal life. Several of the heaps, composed of the smaller organisms, were simply large, brilliantly variegated mounds, containing representatives of the New South Wales marine fauna and flora. In addition to the large and varied accumulation of seaweeds, the beaches were strewn with fish, molluscs, crustacea, worms, alcyonareans, echinoderms, zoophytes, ascidians, and sponges, the two latter being the most abundant. The beaches in some places were carpeted with organisms resplendent with all the colours of the rainbow. Here Mr. Whitelegge was enabled to secure numerous living specimens of sponge, and found them beautifully coloured—reddish orange, dark terra cotta, madder brown, dark yellowish stone, orange buff, yellowish cream, and pale cream. The tints changed after death, one kind, a canary colour, becoming bright purple. Among the commercial sponges, a new species, the *Euspongia illawarra*, is declared to be "quite equal" if not superior to many of the kinds used for domestic purposes. Mr. Whitelegge found the dried skeleton soft and extremely elastic; when wet it was tough, elastic, and apparently very durable. In colour it is a light-yellowish brown. The main fibres are entirely free from foreign bodies such as sand grains and spicule fragments, which are present in nearly all the sponges purchasable in Sydney. In fact, it may be said that all sponges, economic and non-economic, so far examined, have foreign bodies in their composition, but the *Euspongia illawarra* is superior to all previously known in this respect. To use Mr. Whitelegge's own words, "This sponge is by far the best occurring on the coast, and is equal if not superior to many of the commercial sponges procurable in Sydney." The discovery that sponges of commercial value are abundant on the New South Wales coast has raised the question of their systematic cultivation, and here it has been ascertained that it can be readily propagated, as on the coast of Florida, by placing small living cuttings in suitable places. The most favourable location seems to be anywhere within the bays and lagoons free from heavy seas, too strong currents, and too much fresh water; and in moderate depths for easy handling and observation. The growth is faster in strong currents, but in such a case the shape is apt to be poor and the quality harsh. Under favourable conditions the cuttings double their size in six months, consequently eighteen months to two years will produce marketable sponges. The growth

is naturally regulated largely by local conditions, such as temperature, food supply, and situation; and Mr. Whitelegge advises that "after fixation the material with the attached sponge could be transported to places calculated to encourage rapid growth." His own experience teaches him "that the finest specimens of sponges . . . . are generally found suspended under stones or from the roofs of caves. Under such conditions they are shaded from excessive light and possibly have a more abundant food supply, or the inverted position gives the sponge a better chance of obtaining food."

SPANISH OLIVE OIL.

During recent years efforts have been made to improve the quality of the olive oil produced in Spain, so as to enable it to compete in foreign markets with the French and Italian oils, which are so universally appreciated. Some measure of success has already attended these efforts, and this has encouraged the leading Spanish oil crushers to spend money on improvements in their machinery with, it is said, every prospect of a good return. In Barcelona, the pickling of green olives is an important branch of industry; besides the home consumption, which is large, about 7,000 tons are, according to Consul Lay, annually exported. The olives are packed either in bottles or kegs. For pickling, the olives are carefully selected; all those that are in the slightest degree bruised or damaged are rejected, as only the perfect fruit is capable of being preserved. The selected olives are then placed in fresh water to soak for a few days, care being taken to change the water frequently; they are then put into the pickling mixture, which is a solution of common salt and soda, the olives being entirely covered. This is the general method adopted, and though some may slightly alter the solution used, and add to it certain aromatic substances to flavour the olives, the basis of the preparation is invariably common salt and soda. Ripe and half-ripe olives are preserved only in small quantities, as there is little demand for them. Until quite recently little attention was paid to the method of extracting oil in Spain, and consequently in many parts the most primitive methods are still in use. It is usual for the small grower himself to extract the oil from the olives grown on his land; and as he frequently does not own the necessary appliances, he borrows them from the nearest town, paying for their use either in money or oil. These machines are of the most primitive description. The olives are first crushed in a mill turned by a horse or a bullock. They are then placed in lever presses and the oil thus extracted, boiling water being generally used in the process. These wooden presses, though powerful, are very slow, and it often happens that the olives have to be stored until the presses are available, with the result that fermentation sets in, and this naturally detracts from the quality of the oil. It is said that there are between 3,000 and 4,000 of these presses in Spain. Formerly the pulp remaining in the presses was used as fodder or fuel, but now it is sold, and a second extraction of oil is made from it. There are sixty-three mills in Spain for extracting oil from this pulp. The largest oil manufacturers, especially those in the province of Catalonia, have been the first to recognise the importance of improving their machinery; the old crushing mills and wooden presses have been replaced by steel cylinders and hydraulic presses, so that not only is a greater yield obtained, but the quality of the oil is better. Nearly all the machinery in use is of Spanish make. After being extracted, the oil is run into earthenware jars or tin tanks, and after a certain time, strained. It is then poured out into receptacles to be kept until required, alcohol being sometimes used to keep off the action of the air. The lower grades of oil are used in the manufacture of common soap.

General Notes.

ALUMINIUM AS AN ELECTRICAL CONDUCTOR.—In a paper read before the Engineering Section of the British Association, Mr. J. B. C. Kershaw gave the results of tests of the suitability of aluminium as an electrical conductor for bare overhead transmission lines, as a substitute for copper. These tests were made in order to ascertain the resistance to corrosion offered by commercial aluminium rod and wire under the conditions obtaining with exposed bare overhead wires. Samples of aluminium rod and wire were obtained from the principal English firms, and in order to make the series of observations more complete, samples of galvanised iron wire, and of copper and tinned copper wire, were also submitted to atmospheric exposure in two localities in Lancashire. The tests extended from October, 1899, to December, 1902. All the samples of aluminium gained in weight during exposure, and all were pitted and corroded, especially on the under side where the water drops had collected and dried. The rods appeared to have suffered rather less than the wires, and it is therefore probable that in the course of drawing down, aluminium wire undergoes physical change. The author concludes that some of the aluminium rod and wire which was being manufactured and sold in England for electrical purposes in the years 1899 and 1901, was not able to stand atmospheric exposure on the coast of Lancashire without corrosion, and argues that it is only a fair deduction from these exposure tests to assert that aluminium manufacturers have yet to prove the metal a satisfactory and durable substitute for copper in bare overhead transmission lines, or for electrical work which involves exposure to climates near the sea coast.

Journal of the Society of Arts,

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FRIDAY, OCTOBER 2, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

INTERNATIONAL FIRE EXHIBITION.

The Committee of this Exhibition have invited a party of the members of the Society of Arts to visit the Exhibition at Earl's Court on Wednesday, October 14th (afternoon and evening), and inspect the exhibits, including those to which the Society of Arts medals will have been awarded.

The members accepting the invitation will also have an opportunity of seeing the historical pageant and modern fire service display known as "Fighting the Flames."

The members will assemble at 4 p.m. inside the Warwick-road entrance of the Earl's Court Exhibition.

A round of the exhibits will be made in three parties, and the exhibitors will be requested to be in attendance at their exhibits to explain or demonstrate their appliances or work.

Modern fire appliances will be demonstrated at the lake from 5 to 6 p.m. (long ladders from 5 to 5.30 p.m. and fire engines from 5.30 to 6 p.m.).

The three parties will start to view the exhibits respectively as follows:—

Party "A."—Ducal Hall, 4.5 p.m., going by way of Queen's Palace, to Imperial Court.

Party "B" will start viewing in Imperial Court, at 4.10, visiting the Lake, Queen's Palace, and end at Ducal Hall.

Party "C" will commence in the Queen's Palace, 4.10 p.m., visiting the Lake, Ducal Hall, and ending at the Imperial Court.

The London Salvage Corps, by kind permission of Lieut.-Col. Fox, will turn out and drill in the Western Gardens at 6.30 and at 7.30 p.m.

The demonstration in the Empress Theatre will commence at 8.30 p.m. sharp.

The number of the party will be limited to 200. Not more than two tickets can be issued to any one member. They will be issued in order of priority of application. Members desiring to avail themselves of the invitation should apply at once to the Secretary of the Society, stating whether one or two tickets will be required.

In all cases admission to the theatre will be provided as well as admission to the Exhibition.

PRIZE FOR A DUST-ARRESTING RESPIRATOR.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Prize of a Gold Medal, or Twenty Pounds, for the best Dust-Arresting Respirator for use in dusty processes, and in dangerous trades.

The apparatus will be required to fulfil the following conditions:

(1.) It must be light and simple in construction.

(2.) It should be inexpensive, so as to admit of frequent renewal of the filtering medium or of the Respirator as a whole; or alternatively it should be of such construction that it can be readily cleaned.

(3.) It should allow no air to enter by the nostrils or mouth except through the filtering medium.

(4.) It should not permit expired air to be rebreathed.

(5.) The filtering medium, though it should be effective in arresting dust particles, should not offer such resistance as to impede respiration when worn for some hours under the actual conditions of work.

(6.) It is desirable that it should be as little unsightly as possible.

It should be noted that the prize is offered for a Respirator intended merely to arrest dust, and not for a chemical Respirator designed to arrest poisonous fumes. The applications of such chemical Respirators are more limited, and there are special requirements connected with them. The Council have, therefore, preferred to limit the range of their present offer to the simpler and more important cases of

dust, either dust of all kinds or of some special character, *e.g.*, iron or steel.

Inventors intending to compete should send in specimens of their inventions not later than 31st December, 1903, to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C. Such specimens must be accompanied by full descriptions, and in cases in which the apparatus has been put into actual use, the experience of such use should be given.

The Prize will be awarded on the report of judges appointed by the Council.

The Competition is not limited to British subjects.

The Council reserve to themselves the right of withholding the Prize, of extending the time for sending in, or of awarding a smaller Prize or smaller Prizes.

Further particulars will be found in previous announcements in the *Journal*. The last of these appeared on 14th August, 1903.

SECTIONAL COMMITTEE.

The following is the list of the Applied Art Section Committee as appointed by the Council:—

APPLIED ART SECTION COMMITTEE.

Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S. (Chairman of the Council).
Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D. (Chairman of the Committee).
Thomas Armstrong, C.B.
George Frederick Bodley, R.A.
Prof. A. H. Church, M.A., F.R.S., F.C.S.
Sir Caspar Purdon Clarke, C.I.E.
Alan S. Cole, C.B.
Sidney Colvin, M.A.
Walter Crane.
Henry Hardinge Cunynghame, C.B.
Cyril Davenport.
Lewis Foreman Day.
Alfred East, A.R.A.
Arthur Evans, F.R.S.
Sir John Evans, K.C.B., D.C.L., LL.D., F.R.S.
Hon. Sir Charles W. Fremantle, K.C.B.
J. Starkie Gardner
William Gowland, F.S.A.
Gerald C. Horsley.
Arthur Lasenby Liberty.
Seymour Lucas, R.A.
Sir Edward J. Poynter, P.R.A.
Sir Walter S. Prideaux.
Halsey Ralph Ricardo.
Alexander Siemens.
A. B. Skinner, B.A., F.S.A.
John Sparkes.
R. Phené Spiers, F.S.A.
Hugh Stannus, F.R.I.B.A.
H. H. Statham, F.R.I.B.A.
Joseph Wilson Swan, M.A., D.Sc., F.R.S.
Carmichael Thomas.
Sir John I. Thornycroft, LL.D., F.R.S.
Sir Thomas Wardle.
Henry B. Wheatley, F.S.A. (Secretary).

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

PAPER MANUFACTURE.

By Julius Hübner, F.C.S.

(Director of the Dyeing, Printing, and Paper-making Department, at the Municipal School of Technology, Manchester.)

Lecture IV.—Delivered February 23rd, 1903.

Fourdrinier paper machine—Single cylinder and other types of paper-making machines—Finishing—Cutting—Paper-testing—Experimental paper-making.

We will now follow the pulp, as it comes from the strainers, on its journey through the Fourdrinier paper machine (Figs. 22 elevation, and 23 plan,* pp. 858-860), during which it is rapidly converted into a continuous web of paper.

A small box (*d*), provided with a stirrer, is generally placed between the strainer and the machine; from this the pulp flows on to the machine over the so-called "apron," a piece of sheet rubber the width of which is regulated according to the width of paper made. Froth is prevented from getting on to the paper and an irregular flow of the pulp, apt to cause unevenness, is avoided, by means of thin strips of brass which run across the full width of the machine, immediately above the wire, and close to the apron.

The length of these strips, which are termed "slices," as well as their distance from the wire, are adjusted according to requirements. From the "apron," the pulp travels on to the endless wire on which the paper is actually made and which corresponds to the mould of the hand maker. A number of moulds are thus, practically speaking, placed closely together so as to form one endless mould.

The deckle placed on the hand mould, has also its counterpart in the two square rubber bands (*e*) which run on either side of the wire and so prevent the pulp from spreading beyond a certain width. The length of the wire naturally varies very considerably with the kind of paper made and also with the speed at which the machine is run. The mesh of the wire varies from 60 to 100 warp wires per inch. The endless wire is supported at the end nearest to the strainer by the "breast roll" (*f*), whilst it returns at the other end of

* I am indebted to Messrs. Bentley and Jackson, Limited, for the drawings of the Fourdrinier paper machine.

the machine over the lower "couch roll" (*g*). Between the breast roll and the lower couch roll support is given to the wire by a number of hollow brass rolls of smaller diameter in order to ensure a perfectly even surface.

The peculiar shaking motion which the hand maker imparts to the mould after lifting it from the vat is also imitated on the paper machine; the whole of the frame carrying the wire is firmly supported by the lower couch roll whilst the supports under the breast roll rest on movable pivots. A rapid to and fro motion of the frame, gradually diminishing in intensity towards the couch roll, is produced by means of a crank shaft.

This shaking motion, to a certain extent, prevents the fibres from placing themselves in parallel positions on the wire and at the same time promote the intertwining and felting upon which the strength of the paper so largely depends. The width of the paper produced may be regulated at will by adjusting the two "deckle straps," (*e*) which are carried and guided by suitable grooved pulleys on the deckle frame. On modern machines suitable arrangements are provided which enable the shifting of the deckle straps and the corresponding alteration of the width of the web to be carried out without necessitating stoppage of the machine.

The water which passes through the wire and which carries along with it a certain amount of fibres, loading materials, size, &c., is called the "back water."

As already mentioned, to obtain uniformity in certain classes of paper it is necessary to collect the back water and to use it in place of fresh water for diluting the pulp coming from the stuff chest. It being in many instances impossible to use all the back water for this purpose, suitable "save-alls" or "fibre-catchers," such as the "Bertram" and the "Füllner," are provided. The use of these latter is of the utmost importance, not only upon the ground of economy, but also in connection with the question of the prevention of river pollution; this problem, with which the paper-maker is constantly confronted, may be solved to a very considerable extent by the provision of suitable arrangements for the purification of the back water in the mill.

The speed at which the wire travels varies according to the kind of paper made and according to the construction of the machine; 500 feet per minute is the highest speed obtained on "news" machines in the author's experience.

During its passage along the wire the pulp gradually loses water but not, however, to a sufficient extent to give such a consistency and strength to the web that it can be removed from i s support without breaking; in order to make this possible recourse is made to artificial drying. For this purpose two or more suction boxes (*h*), constructed either of wood or metal, and divided into compartments, are placed immediately below the wire, before it reaches the couch rolls; an outflow pipe of a certain length is fitted to the bottom of each box. The box, when filled with water, with the outflow pipe closed and with the wire carrying the wet paper on the top of it, is, practically speaking, hermetically sealed. If the tap provided on the outflow pipe is now opened and if the box is just kept full of water, a partial vacuum is produced underneath the paper and the atmospheric pressure rapidly forces the water out of the web into the suction box. When suction by means of outflow pipes proves insufficient, specially designed vacuum pumps are fitted to the suction boxes.

Water-marks are not produced in "machine made" paper by wires sewn on to the wire cloth upon which the paper is formed, as in the case of "hand made," but by means of the so-called "dandy roll;" this is a cylinder, covered with wire gauze, on to which the design of the water-mark is sewn and which, by revolving and pressing upon the surface of the soft paper, usually between the suction boxes, produces the required impression. The first "dandy roll," at the time called a "wove riding roll," was made (according to Hofmann) by John Marshall of London and supplied to Matthew Towgood in the year 1827. Wove paper is produced by covering the dandy roll with ordinary machine wire.

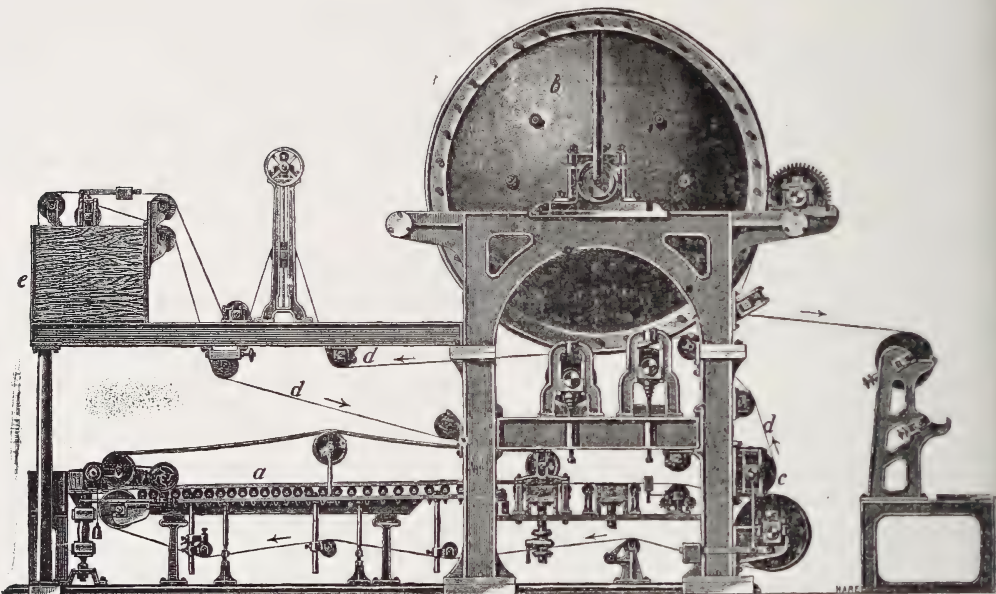
The web of paper, still containing a considerable amount of water, has next to pass between the couch rolls. It has already been pointed out that the wire is conducted back over the lower couch roll on the top of which, but generally slightly behind, revolves the top couch roll (*i*); this top roll is covered with a tightly-fitting felt tube, called the "jacket," and is firmly pressed against the lower roll by means of screw or lever pressure. A scraper, called the "doctor," a spurt pipe and a revolving brush are usually provided for the purpose of freeing the felt from particles of paper which it may have retained.

After the paper has been pressed between the couch rolls it should possess sufficient

strength to allow of its being parted from the supporting wire. It now travels, unsupported for the first time, for a short distance to the "first press felt."

Considerable skill is required on the part of the men in conducting the moist web of paper from the couch roll to the first endless press felt; along this felt the paper travels to the first wet press (*j*), which consists of two bowls made of cast-iron or of granite, or of cast-iron covered with hard rubber or bronze. Pressure is applied to the top roll and a considerable amount of water is thus pressed out of the paper; small particles of paper which stick to the top roll are removed by a steel "doctor."

FIG. 24.



The paper, after leaving the first press rolls, is always slightly marked on the side on which it has been in contact with the felt, but a uniform finish on both sides of the paper is obtained by passing the web on to another wet felt and with this through a second wet press (*k*). This time, however, the paper enters the press from the back so as to bring the other side into contact with the upper press roll.

The action of the wet presses naturally depends, to a very considerable extent, upon the readiness with which the felts are capable of absorbing the water. The felts, therefore, have to be changed frequently and cleaned in special felt washing machines.

At this stage the paper still contains a considerable amount of moisture which has to be eliminated by drying. Slow drying, as is customary with hand-made paper, is out of the question on account of the enormous production of our modern quick running paper machines. The first Fourdrinier machine, built by Bryan Donkin, had no drying arrangement, the paper being taken from it in a moist condition, cut and dried in a drying chamber. J. B. Crompton, of Manchester, may be considered as the inventor of the drying cylinders now attached to the paper machine. The number of drying cylinders varies very considerably with the kind of paper made and with the speed at which the machine runs; these cylinders are made of cast iron, highly polished, and are heated by steam. As the paper comes from the last wet press it is conducted to the drying cylinders (*l*), against which the paper is pressed by an endless felt, called the "drying felt" (*m*). Special stretching rollers are provided in order to keep the felts tight and in many cases the drying of the felt is facilitated by the addition of separate drying cylinders (*n*).

The drying cylinders are generally arranged in batteries and in some machines the paper is passed through a small calender called the "smoother," which is placed in front of the last set of cylinders. The "smoother" consists of a pair of highly polished chilled iron rollers to which pressure is applied by means of screws and levers. The paper being in a

damp condition, whilst passing between these rollers, is capable of taking a high class finish.

It is always preferable to perform the drying as slowly as possible because rapid drying, as also drying at high temperatures, usually results in a paper of inferior quality, especially in so far as its strength and sizing are concerned. The first two or three cylinders should be but slightly heated, because overheating at this stage frequently causes cockling of the paper.

The surface presented by the paper after it leaves the last drying cylinder is not sufficiently even or smooth for many purposes. Printing papers which have been engine-sized are usually finished by a passage through one or more sets of calender rolls (*o*), forming part of the paper machine; these are placed immediately after the drying cylinders.

After having passed over the drying cylinders the fibres constituting the paper are in a state of absolute dryness and therefore incapable of taking a superior finish. It being impossible to regulate the drying so as to leave a definite amount of moisture in the paper before passing it through the calender the paper has next to be damped. For this purpose it may be conducted over revolving copper cylinders placed in a trough containing water or over a cooled cylinder against which a jet of steam is directed. Rotating brushes which spurt water against the surface of the paper, or some other arrangement such as the "spray damping machine" in which water is very finely divided by means of compressed air, are also used.

The bowls, of which there are usually from four to twelve in one calender, are made of chilled iron and in some calenders provision is made for heating some of the bowls with steam; pressure is applied by screws and levers or in modern arrangements by means of hydraulic rams. In many instances the paper is cut on the machine lengthways, so called "slitter knives" (*p*), being used for this purpose.

The reeling apparatus (*q*), forms the final part of the paper machine. It consists of a number of rollers each of which is independently driven and on which the paper is wound; provision being made so as to allow of the finished reel of paper being replaced by an empty core, without causing loss of paper.

Among the other types of paper machines I will first describe the "single cylinder machine" or "Yankee machine," also called the "M.G. machine," Fig. 24 (Messrs. James Bertram and Son, Ltd.), on which are made machine glazed papers, such as "caps," very highly glazed on one side only. It consists of a wet end (*a*), similar to that of an ordinary Fourdrinier machine but contains only one drying cylinder (*b*), this being of large diameter and having a very highly polished surface.

The paper is taken from the couch press (*c*) on to an endless felt (*d*), by which it is pressed against the surface of the cylinder so that it remains in contact until perfectly dry. After leaving the paper the felt is run through a washing machine (*e*), in order to remove absorbed impurities.

Paper machines with two wet ends have been constructed with the object of pressing both webs together as they come from the couch rolls. Differently coloured papers, as well as papers of varying composition, may thus be firmly united.

In the Imperial Russian paper mills, papers bearing peculiar water-marks very difficult to counterfeit, are made on a machine which consists of three wet ends of the "Fourdrinier" type. Each of the three webs is separately water-marked and the machines are so accurately regulated that in pressing the three moist sheets together, the water-marks register perfectly.

The "cylinder paper-machine" (Figs. 25 and 26), in which the paper is formed on a revolving cylinder covered with fine wire gauze, was invented by George Dickinson, about 1820. The cylinder (*a*), is contained in a trough (*b*), to which the paper pulp is conducted. The water which passes through the wire flows out through the hollow journal (*c*), whilst the fibres become deposited on the surface of the cylinder. The paper thus formed is removed from the wire by an endless felt (*d*), which is pressed against the cylinder by the couch roll (*e*). The cylinder itself therefore forms practically the lower couch roll. To obtain a paper of uniform thickness two or more cylinder machines are usually combined and the wet sheets pressed together. Cylinder machines are mostly used for the manufacture of various thick papers and boards.

Although shaking devices have been proposed for use with cylinder machines, the paper which they yield does not possess the uniform appearance and is not so thoroughly felted as are papers made on the Fourdrinier machine. An interesting form of board machine, consisting of four paper machines, namely, two Fourdrinier and two cylinder machines, one of the latter containing

three cylinders and one containing one cylinder only, may be mentioned. Four distinctly different kinds of paper, varying in thickness, can be made on this machine and pressed together to form one board. The obvious advantage of this is that finer paper may be used for the outside, whilst cheaper materials are used for the inside of the board.

Imitation hand-mades, which have the characteristic deckle edge, can be made on

second cylinder (*h*), and the second couch roller (*i*), and further with the felt to the press rolls (*u*, *t*).

Hand paper-making is very ingeniously imitated on the "single sheet machine," invented by Sembritzky. In this machine the pulp is conducted to a box, the bottom of which contains a number of narrow outflow pipes of convenient length. A swimmer, with holes, corresponding in position with these tubes,

FIG. 25.

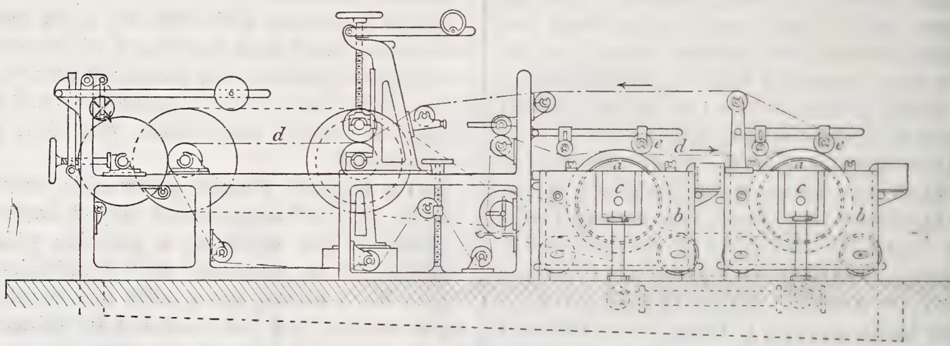
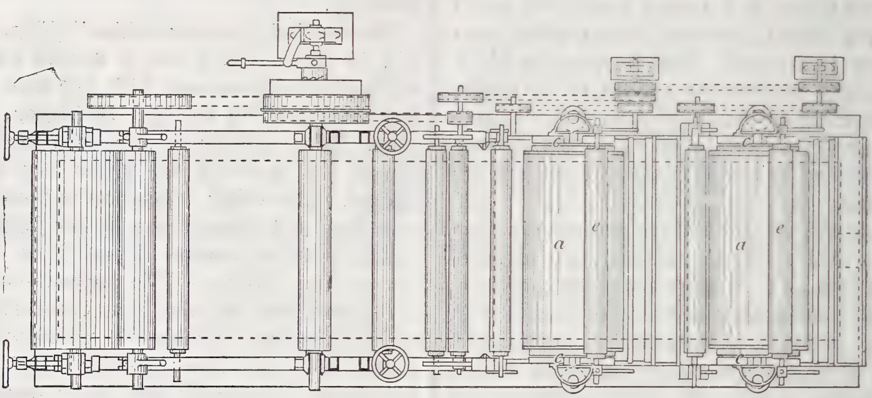


FIG. 26.



cylinder machines. For this purpose thin strips of rubber or other material are fixed on the wire of the cylinder so as to divide the web into single sheets.

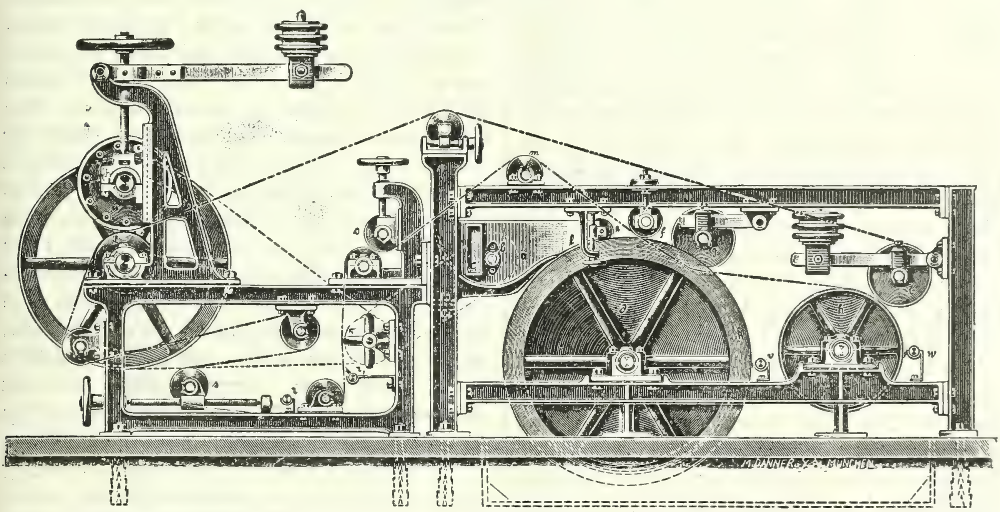
Graham's patent cylinder or board machine (Messrs. J. Marx and Co.), which is shown in Fig. 27, differs from the ordinary cylinder machine in that the cylinder (*d*), does not revolve in a vat; the pulp travels over the apron (*l*), between the deckle straps (*k*), on to the cylinder. The preliminary couch roll (*f*), presses the felt lightly against the stuff and the sheet is taken off from the cylinder by the couch roller (*g*); it then passes between the

presses the pulp causing it to overflow through the tubes on to a frame, covered with wire gauze, which resembles the hand mould. The water is extracted by suction whilst the mould is shaken laterally and pressed against a couch roll over which an endless felt travels. The sheet is transferred from the mould to this felt and conducted to a wet press. The empty mould is then rinsed and moved back to the pulp distributor.

Machine-made papers which have to be tub sized are either only slightly sized with rosin in the beater, or are made without any addition of size. A solution of glue or gelatine, to which

alum and in some cases soap is added, is used for sizing purposes. The web of paper is run through the size, contained in a trough, the excess being pressed out by rollers. Tub sized papers have to be dried very slowly in order to prevent the size from coming to the surface of the paper and thus making it too hard. For this purpose the paper is conducted over a large number of skeleton cylinders contained in a heated chamber and provided with fans. Special automatic drying machines, as used in drying stained and surface-coated papers, are also applied to this purpose. In many cases it is necessary to rewind the paper carefully before sending it to the printer or before finishing on the calenders. A reeling apparatus, by means of which the paper is wound tightly whilst under pressure on a wooden or iron core, is used for this purpose.

Fig. 27.



The surface of paper as it comes from the paper machine is for many purposes not sufficiently smooth; it has to be finished, either in the web or in single sheets, to suit particular requirements.

The "web glazing," as the former operation is called, consists in passing the web of paper through a calender or calenders in which it is strongly pressed between iron bowls and compressed paper or cotton bowls. Pressure is applied to the bowls by screws and levers or by hydraulic rams. The iron bowls are usually heated by steam.

A finish distinctly different from the ordinary calender finish is produced by friction glazing. The "friction calender" used for this purpose consists of one large paper bowl on the top of which revolves at a higher speed a smaller, highly-polished steel bowl. The paper is pressed and smoothed at the same time by means of the friction thus set up, and a very high finish is obtained by this method of glazing.

Although sheet finishing is sometimes done on the ordinary calender, "plate glazing" is more frequently resorted to. In this operation the single sheets are placed between highly polished zinc or copper plates, and pressed between heavy iron bowls. The plates are moved backwards and forwards several times between the bowls, after which the sheets are removed and again placed between plates for a second pressing.

"Embossing" is another method of calendering by means of which designs are pressed into the surface of the paper. The embossing calender consists of two bowls, one of cotton or paper and the other of steel, upon which the design is engraved.

The cutting of papers lengthways is accomplished by slitter knives such as are used in combination with the paper machine. Special sheet cutters are provided for cutting the web into single sheets. Four or more reels of paper are conducted to one of these machines simultaneously and at a uniform speed. A revolving drum, which carries a knife, cuts the paper once every revolution; the other cutter is a

stationary knife, fixed on the table over which the paper travels.

Water-marked papers have to be cut very accurately at equal distances between the water-marks; cutters with special clamps gripping the paper and bringing a certain length of paper forward to the cutting knives each time, are used for this purpose.

The "Guillotine" cutter is one type of cutter, which is used for trimming sheets or dividing large sheets into smaller ones. The essential part of this cutter consists of a heavy knife which, in its diagonal downward movement, cuts through the pile of sheets firmly pressed together on the cutting table.

The importance of testing papers systematically has been recognised in various countries, but especially in Germany. The pioneer in this branch of testing was the splendidly equipped testing Institute at Charlottenburg: this establishment includes a department devoted entirely to paper testing, with the development of which the name of its Director, Prof. Herzberg, is intimately connected. The great value of paper testing does not consist alone in ascertaining the quality and the properties of a given sample; the result of systematic tests cannot fail to be invaluable to the paper-maker, because, by their consideration, irregularities will be exposed and remedies will suggest themselves.

The real object of the testing institute was not at first recognised by the German paper-makers. The idea prevailed that such conditions would be exacted as would only subject the manufacturer to further heavy burdens. Experience has proved, however, that the testing institute is a true and valuable friend to the paper-maker. The preface of Herzberg's second edition of "Paper Testing" (Papier Prüfung), contains a letter addressed by the German Paper-makers' Association, in 1900, to the Ministry of Education, which expresses the prevailing opinion so clearly, that I think it will be of interest to give a translation of it here:—

"The work of the Charlottenburg Institute since its foundation, has been followed by the German paper-makers with the greatest interest. Although at first it was not considered always convenient to have the department of paper testing, which was established simultaneously with the institute, as a severe judge, no attempt has been made to conceal that paper testing has been a powerful factor in contributing to the growth, the importance, and the prosperity of the industry, and in establishing its fame as against foreign countries."

To bring paper testing to the position which it should occupy in order to be of real value to the industry, it must be conducted on lines similar to those adopted by the Prussian authorities.

Proper paper standards should be established; these have proved a boon, not only to the buyer, but also to the paper-maker. The results of all the tests, as well as of investigations into the composition of foreign papers which compete against the home industry in our markets, ought to be published periodically and thus placed at the disposal of our manufacturers.

In many instances, conclusions may be deduced from the results of these tests which might prove to be of value to the paper-maker. Very often it will be found of importance to ascertain microscopically the kind or kinds of fibres from which a paper has been made. For the microscopical examination of papers are required a good microscope and various chemical reagents by means of which the fibres are coloured. To prepare a paper for examination, it is necessary to disintegrate it by boiling small pieces, taken from various parts of the sheet, for ten to fifteen minutes in a weak solution of caustic soda (about 1 per cent.); during this operation papers containing mechanical wood are coloured yellow. The boiled paper is now placed on a fine sieve, washed free from soda, and transferred to a bottle containing garnets. After a short shaking with water, the pulp is drained and is then ready for the preparation of the slides.

The chemical reagents used for facilitating the investigation are potassium iodide iodine solution, and zinc chloride iodine solution. On placing a few drops of the former on a small quantity of the pulp placed on a slide, the principal fibres show the following colouring:—Linen, cotton and hemp—light to dark brown. Straw and jute cellulose—grey. Wood cellulose and esparto—partly grey, partly brown. Manila hemp—partly grey, partly brown, partly yellowish brown. Wood pulp (mechanical) and raw jute—partly yellow, partly yellowish brown.

Zinc chloride solution gives the following reactions:—Cotton, linen, and hemp—claret red. Wood, straw, esparto, and jute cellulose—partly blue, partly reddish and blueish violet. Manila hemp—blue, blueish violet, dull yellow, and greenish yellow. Wood pulp and raw jute—lemon to dark yellow.

Before applying zinc chloride solution, the pulp must be freed from water by squeezing it

on a porous plate. The fibres have to be separated with a pair of platinum preparing needles and then covered with a thin cover glass.

Considerable experience is required in working with the microscope and a careful study of the structural characteristics of the different fibres is essential.

Cotton fibres appear under the microscope as flat ribbons, usually twisted upon themselves. The flax fibre appears round and fairly regular, and shows a distinctly visible narrow central canal. Numerous dark lines run cross ways, and are due to pores in the fibres. The so-called linen bulbs are very characteristic widenings of the fibre. Hemp fibres, as present in papers, cannot be distinguished with certainty from flax fibres. Mechanical wood shows a ragged torn appearance and its structure is not a fibrous one. The pitted vessels or pores, which appear in the shape of two concentric rings, are very plainly visible. Cross markings on many of the wood cells may also be frequently noticed. The bast fibres of jute are distinguished by a distinctly visible canal, the width of which varies considerably. In some places it is completely obliterated, and appears as a single line.

Wood cellulose fibres are usually flat, often twisted and not unlike cotton. In many instances the characteristic rings as seen in the mechanical wood are plainly visible in the cellulose.

Straw fibres are round and smooth and accompanied by numerous cuticular cells some of which are very wide and flat whilst others are peculiarly marked and serrated. The spiral shaped cells carry a ring at each end and although the cells are mostly torn, the rings may be always found in straw papers.

Esparto fibres and cells are very similar in appearance to the straw fibres and cells. The characteristic small pear-shaped hairs or cells, which are always found in esparto papers, afford, however, a ready means of distinguishing esparto from straw.

To ascertain the respective quantities of fibres present in a paper it is necessary to compare the microscopic preparation with fibre mixtures of known composition. Very considerable experience is, however, required to obtain results possessing a high degree of accuracy.

The thickness of a paper may be ascertained by using one of the ordinary micrometer arrangements, such as those of Schopper, Rhese and others by means of which measurements may be conveniently made to within 0·001 mm.

Before proceeding with the testing of machine-made papers, the machine way and the cross way of the paper respectively must be ascertained. Both methods used are based on the assumption that the fibres in the machine way are more closely felted than in the cross way.

Valuable conclusions may be drawn from the results of determination of the resistance which a paper offers to tearing. Papers which have to be tested should be kept for some time in a room the air in which contains a known percentage of moisture, as the results are considerably influenced by atmospheric conditions. Strips, 15 mm. in width, are then cut length ways and cross ways from different sheets.

The chief tearing machines used in paper tearing are those of Schopper, Hartig-Reusch-Leuner, and Wendler. In Schopper's type, the strip of paper, 180 mm. in length, is suspended vertically between two clips, and by means of a simple hydraulic device, the load is gradually increased, until the strip breaks. The breaking load and the elongation are indicated on two scales.

In the Hartig-Reusch-Leuner type of machine, tension is put on the strip by means of a steel spring, and the breaking load as well as the elongation are given in the form of a curve, the apparatus containing an automatic registering device.

The Wendler tearing machine, in which the load is increased by means of a spring, differs from the last named in that the breaking load and the elongation are indicated on separate scales.

The tensile strength of papers may be very conveniently expressed by giving the length of a strip of paper which, if fastened at one end and allowed to hang free, would break by its own weight. The width of the strip is immaterial.

The resistance which a paper offers to crushing, rubbing, and folding, may be considered as next in importance to its resistance to tearing. Although a paper may be quite good so far as tearing is concerned, its resistance to rubbing, &c., may not necessarily be so satisfactory. Tests of this kind have until lately been exclusively made by hand, a method the results of which obviously depend much upon the individual by whom the tests are made. Schopper has constructed a special machine for this purpose which has been found to give reliable

FIG. 28.

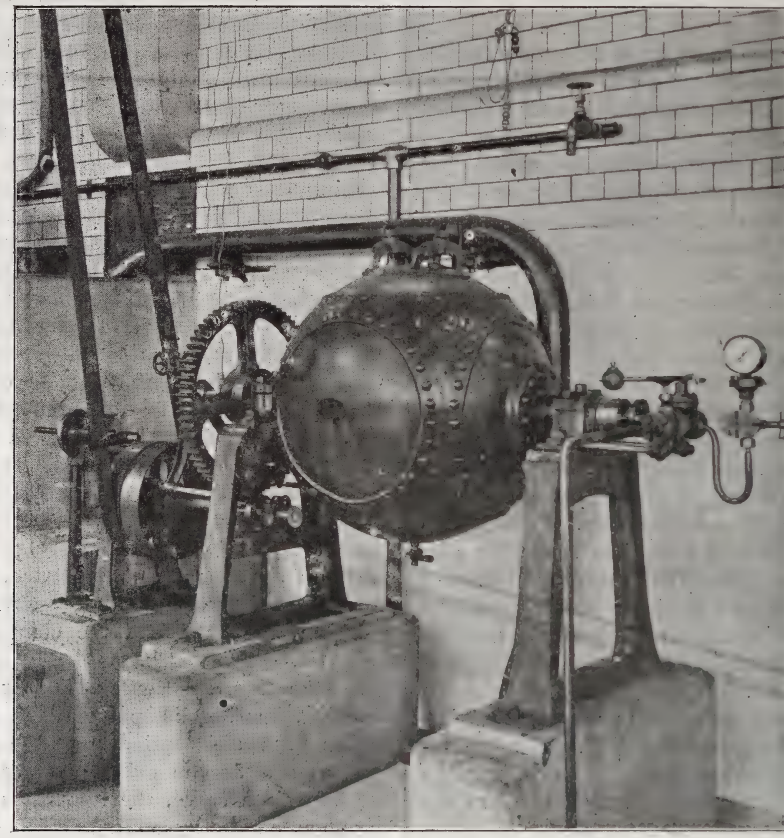
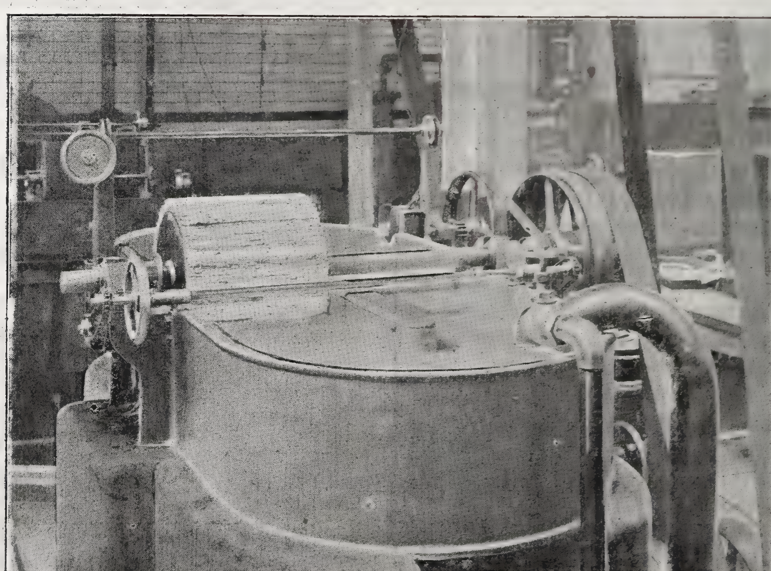


FIG. 29.



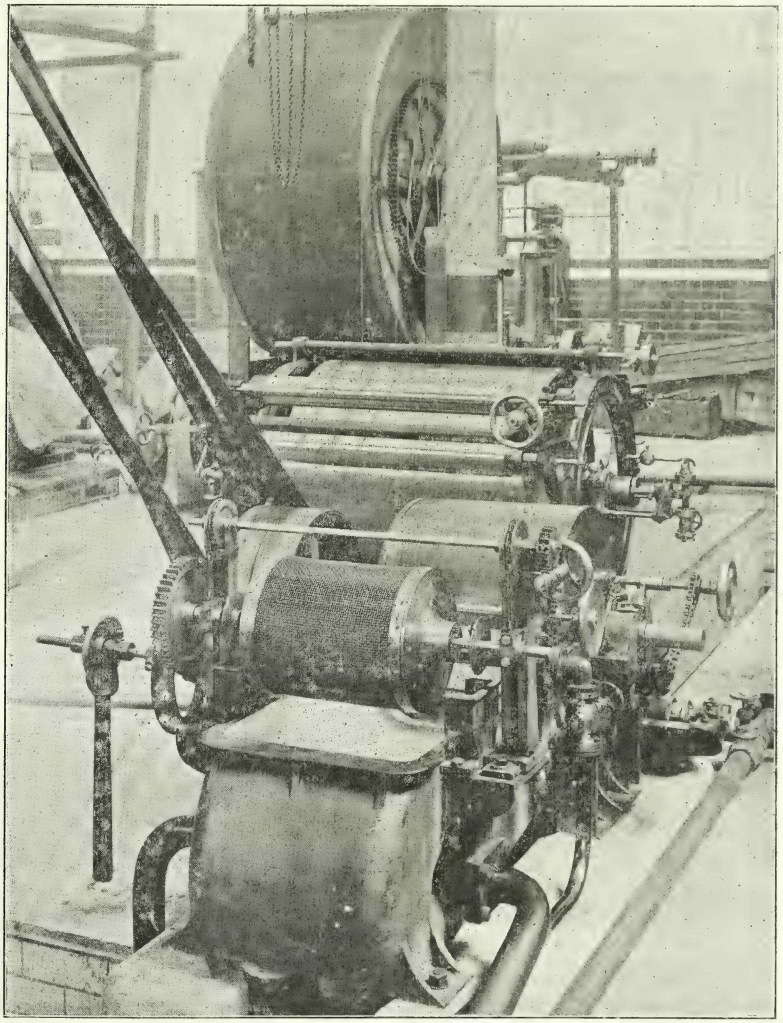
comparative results. By means of a crank shaft, provided with a slit, the strip of paper is folded backwards and forwards until it breaks. A counting device indicates the number of times the strip has been folded.

The amount of ash which a paper contains depends to some extent upon the kind of fibres which have been used in the manufacture because the amount of natural ash of the fibres varies considerably. Thus white linen contains about 0·2 per cent. of ash, whilst adansonia yields about 7 per cent.

The quantity of ash in a paper is ascertained by incinerating a weighed piece of the paper in a skeleton cylinder made of strong platinum wire. The residue is weighed either on a chemical balance or on Post's or Raiman's ash balances which are specially adapted for this purpose.

In examinations possessing a high degree of accuracy, chemical changes which may occur during incineration must be carefully taken into consideration.

Fig. 30.



Rosin size in a paper may be readily detected by boiling a small piece with glacial acetic acid and pouring the product into distilled water. The water will become opalescent if rosin size is present. The presence of starch in a paper is ascertained by means of potassium iodide iodine solution, with which the characteristic blue colouration is obtained.

An excellent reagent for animal or tub-size

is Millon's reagent, *i.e.*, mercuric nitrate. Tub-sized papers, if moistened with this solution and slightly warmed, turn pink or red.

Papers which are used for special purposes, as for instance, for the wrapping of polished steel and other articles, should be carefully examined for free chlorine and for free acid. A quantity of the paper is extracted with boiling water and the extract tested for free chlorine with potassium iodide starch paper and for acid with Congo red solution, a colouring matter which turns black with free acids.

The ink and water resisting qualities of papers are tested by means of solutions of ferric chloride and pure tannic acid, which, when mixed, produce a black colour lake. The ferric chloride solution is applied to one side, the tannic acid to the other side of the paper. Penetration and consequent contact of the two solutions will be impossible if the paper is hard sized, whilst the grey or black discolouration will rapidly appear on soft sized papers.

The presence of mechanical wood in papers may be detected by the characteristic reaction with solutions of aniline sulphate (yellow), naphthylamine hydrochloride (orange), and phloroglucinol (magenta red). The quantity of mechanical wood can be ascertained with a certain degree of accuracy, by comparing the depth of colour produced with that given by paper of known composition.

In many chemical industries, such for instance, as those concerned with the manufacture of the simpler coal tar products, the results of laboratory research can be immediately applied in the works itself. The mechanical appliances used on the large scale are, as a rule, of a quite simple character and the carrying out of the preparations in the works is not complicated by the necessary use of highly intricate machinery.

In the cases of other industries of a chemical character, such as bleaching, dyeing, calico printing and finishing, the application of any

FIG. 31.

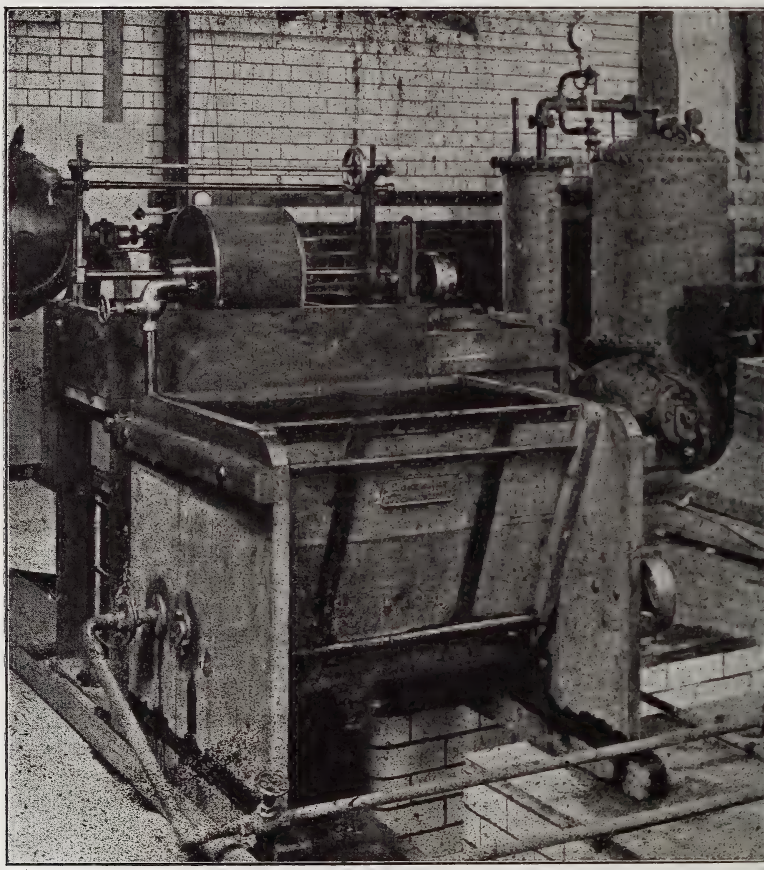


FIG. 32.

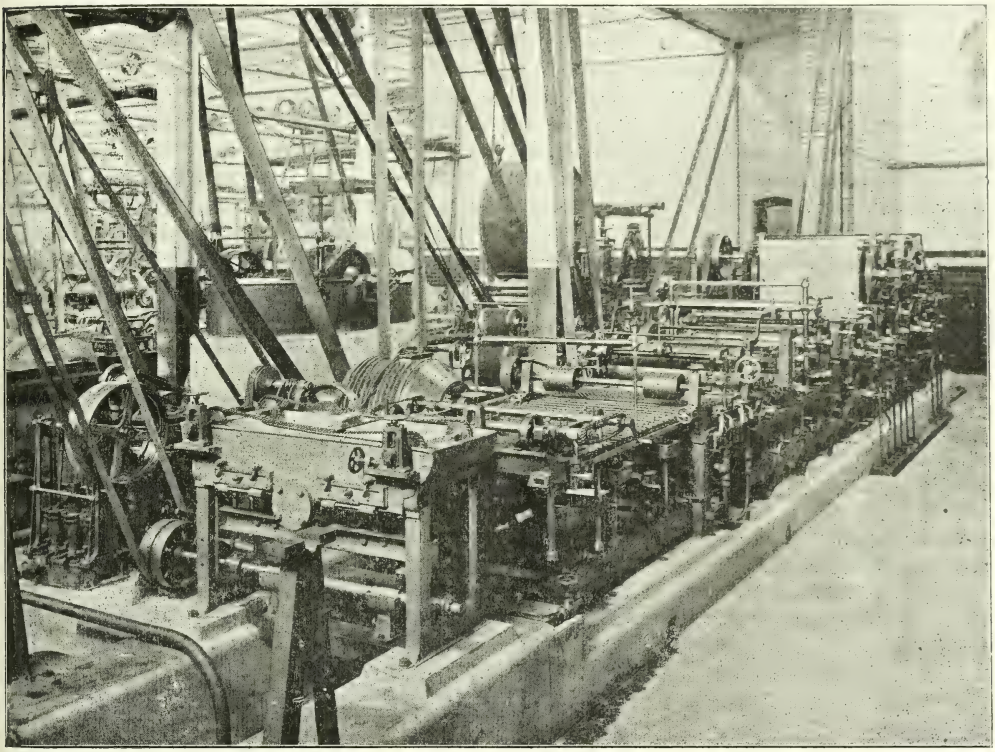
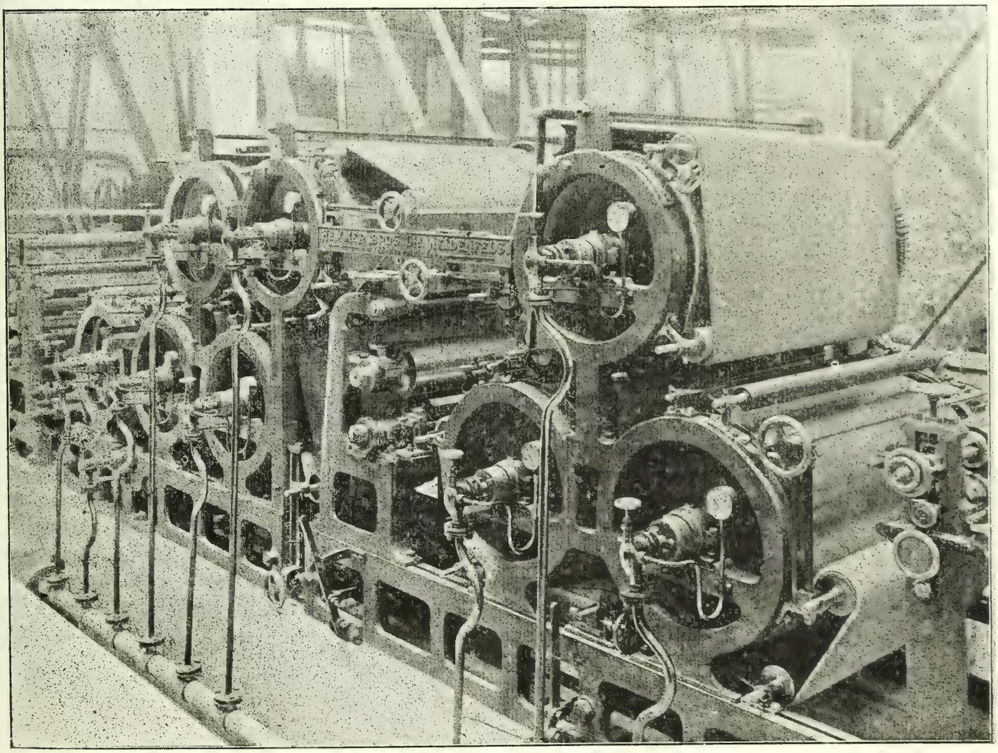


FIG. 33.



chemical reaction is naturally greatly modified by the necessity for employing mechanical appliances of great complexity.

Paper-making stands practically alone, in that the important operations concerned are such as interest the chemist and the engineer in an almost equal degree.

In all work concerned with the development of the paper-making industry, it would seem natural to ascertain in the chemical laboratory the direction in which progress is possible and then to determine, by experimental work on machines of an industrial type, the best method of practically applying the result; the carrying out of the latter part of the plan upon actual machinery in the mill is obviously impossible on account of the enormous expense incurred. The provision of machinery upon which the requisite experiments can be performed upon a scale comparable in magnitude with actual industrial work, is therefore absolutely essential.

Although slight differences will necessarily be observed between the experimental results obtained with a small plant such as that referred to, with the actual industrial machinery, comparative trials between the two machines are bound to agree sufficiently closely for practical purposes.

Since it is now universally recognised that students cannot be properly trained for any scientific industry without cultivating their faculty of initiative by instruction in the methods of original research, it is obvious that a plant of this description cannot fail to be of enormous educational value. By the study of the results obtained with the plant under all possible working conditions, the student not only becomes acquainted with the details of the intricate machinery involved, but has his attention strongly drawn to the possibility of improving the materials, the methods, and the machinery. In this connection it cannot be too often pointed out, how very few facts have as yet been established which give us satisfactory explanation of the numerous factors with which the paper-maker has to deal.

The necessity of conducting research on a practical scale has long been acknowledged in dyeing, printing, &c., and on the Continent schools have been equipped with machines specially constructed for the facilitation of experimental operations and research; no school of paper-making of this character has, however, up to the present been established.

Keeping this in view, the Municipal School of Technology of Manchester, has launched out on a unique scheme, in the equipment of a practically complete small scale paper-mill for experimental purposes, and for the carrying out of research on an industrial scale.

The equipment includes the following appliances:—Stationary and revolving spherical high pressure boiler, breaking engine of the Holländer type (porcelain lined) with drumwasher, draining chest, patent Hemmer refining engine, stuff chest with stuff regulator and mixing box, sand tables, and a flat vacuum strainer. From the strainer, the pulp may be conducted either to the "hand-made" plant, or to the paper machine. The hand-made plant comprises:—Drainer with drum washer, vat provided with stirring arrangement, screw press for couching, and a specially designed drying cylinder for the rapid drying of hand-made papers.

The plant for "machine made" paper, comprises a complete small Fourdrinier machine, with two suction boxes, dandy roll, two wet presses, two batteries of drying cylinders containing five and three cylinders respectively, a smoothing calender placed between the drying cylinders, slitter knives, and reeling apparatus.

The finishing plant comprises—a combined spray and brush damping machine, rewinding apparatus, sheet cutter for cutting water-marked papers, ordinary four-bowl and friction calender, plate-glazing, and embossing calender. The machines are driven by electro-motors, provided with special speed regulators, by means of which the speed may be varied from normal to + or − 30 per cent.

The paper-testing laboratories are provided with all the modern testing appliances, such as micrometers, the various types of tearing machines, microscopes, chemical and ash balances, hygrometers, humidifier, a single fibre tearing machine, a specially-designed apparatus for making comparative dye tests on paper pulp, a complete micro-photographic outfit, drying stoves for mechanical wood, and other appliances.

The illustrations (Figs. 28-33) show the experimental paper-making plant at the Municpal School of Technology, Manchester.

Fig. 28. Spherical boiler.
,, 29. Breaker.
,, 30. Hemmer beater and sheet-drying cylinder.
,, 31. Vat.
,, 32. Fourdrinier paper-machine with strainer.
,, 33. Drying arrangement of the paper-machine.

The principal object of such a school as the Manchester School of Technology, namely, the education of the future captains of industry, does not consist in teaching the youths merely the technology of paper-making, &c., and in simply making them acquainted with the processes and the machinery employed; this stage of the work must be regarded as only the final part of the whole educational scheme. The foundation of the training of a successful technologist, consists in a high-class general education; this must be followed by a sound training in mathematics, chemistry, physics, mechanics, and mechanical engineering.

Carried out in accordance with such a scheme as this, technical education in paper-making cannot fail to be a success; if any other method be adopted, failure will be the almost inevitable result.

In a school of this character it is essential that the relations existing between the manufacturers and the school should be of a most intimate character, as only if this be the case can such an institution become of value to the industry of the country. Such a state of affairs exists on the Continent, and has beyond doubt contributed greatly to the material welfare of the countries concerned.

Miscellaneous.

*THE CAUSE OF THE LUSTRE PRODUCED ON MERCERISING COTTON UNDER TENSION.**

It is generally supposed that the production of a lustre on treating stretched cotton yarn with strong caustic soda is conditioned by only two factors, namely, however, that a third effect is essential to the production of any appreciable silky lustre; this consists in an uncoiling of the naturally twisted ribbon constituting the cotton-fibre.

On immersing a loose cotton-fibre in strong caustic soda on the microscope stage, it is seen to rapidly untwist, to swell, and at the same time to shorten in length; the untwisting generally continues until the natural twist has nearly completely disappeared, after which the fibre presents the appearance of a round, irregularly curved rod, with a comparatively smooth surface. If the fibre is fixed at one end and treated with caustic soda it twists either to the right or to the left, according as it was originally coiled towards the left or towards the right; in the most generally occurring case that, namely, in which the fibre is coiled partly to the right and partly to the left, the untwisting attending the treatment with soda takes place first towards the left and then towards the right or *vice versa*. If the fibre is prevented from contracting by being held at the two ends in a stretched condition it still untwists when treated with soda; since, however, the whole of the untwisting does not take place simultaneously, the untwisting of one part causes another part, which has already become unwound and attained the condition of a gelatinous rod, to become tightly twisted in the opposite direction to its original twist.

The stretched fibre thus again acquires a corkscrew-like appearance, part of the twist being right and left-handed, with the difference, however, that whilst the raw fibre forms a twisted ribbon creased or folded at the turns, treatment with soda converts it into a rod of circular cross-section which has been twisted whilst in a gelatinous state. The twisting of the fibre under these conditions results in the production on the rounded surface of spiral ridges possessing smooth curved contours, which reflect the light at all angles of incidence and reflection, just as do the coils of a polished corkscrew. The fibre, therefore, becomes lustrous.

The high degree of transparency possessed by the cotton-fibre introduces difficulties into the microscopic examination of the changes referred to above. But although the fibre is amorphous, it is doubly refracting owing to internal strain; the authors therefore find it convenient to conduct the microscopic examination of the fibre between crossed Nicol prisms, and to accentuate the difference in tint of the various parts by introducing a one-eighth wave-length retardation plate of mica between the Nichols in such a way that its principal directions make an angle of 45° with those of the prisms. This enable the internal canal, cracks in the surface, and differences in thickness to be made out with great ease. The correctness of the explanation now given of the lustre is shown by a series of photomicrographs taken in natural colours in elliptically polarised light under the conditions just referred to; the authors have to thank their colleague, Mr. Chas. W. Gamble, Director of the Photographic Department in the Manchester Municipal School of Technology, for having assisted the work by the production of these photographs. A further confirmation of the correctness of the conclusions now arrived at is afforded by the observation that whilst cotton-fibres mercerised loose have a practically circular cross-section, fibres treated under tension with soda show cross-sections shaped like polygons with rounded corners.

An independent proof of the authors' conclusions that the untwisting of the fibre is as essential a factor in the production of the gloss as are the swelling and the shrinking, is afforded by an examination of the action of reagents on cotton yarn. Thus, hanks of a long staple yarn having a mean breaking strength of $417{\cdot}4 \pm 2{\cdot}1$ grams were immersed loose in caustic

* Abstract of a paper read by Julius Hübner, F.C.S., and William J. Pope, F.R.S., before the Chemical Section of the British Association at Southport.

soda (sp. gr. 1·342) and saturated barium mercuric iodide solution, and the following changes in the breaking load of the yarn and the lengths of the hanks were found to result:—

Caustic Soda.—Mean breaking load, 526 ± 3 8 grams; shrinkage, from 36·0 to 44·8 cm.

Barium Mercuric Iodide.—Mean breaking load, 526·6 ± 3·3 grams; shrinkage, from 66·0 to 48·9 cm.

Although the shrinkage and the increase in the breaking load brought about by these two reagents is so nearly the same, yet on immersing hanks under tension in these solutions and washing whilst still under strain, the hank treated with soda acquires a brilliant lustre, whilst that treated with the iodide exhibits only a trace more lustre than the untreated yarn. The explanation of this result is found in the fact that caustic soda causes rapid untwisting of the fibre, whilst barium mercuric iodide does not cause untwisting.

The authors give a list of reagents which bring about two of the three effects shown to be essential to the production of lustre—namely, swelling, shrinking, and untwisting—and find that "lustreing" cannot be effected with such reagents; several solutions are known, however, which cause the three effects, and with the aid of such liquids the lustre can always be produced.

TEA DRINKING IN INDIA.

A movement was started in Calcutta on the 1st of August, 1901, to increase the consumption of tea in that country especially by the native inhabitants. Heretofore the producers of Indian tea, while keenly alive to the importance of pushing the sale of their produce in British colonies and foreign countries, had neglected a possibly large market at their own doors. The first idea of those responsible for the establishment of the Indian Tea Markets Expansion Commission was to form a limited company, but this seemed incompatible with the scheme of a purely national agency. Eventually the offer of Messrs. Andrew Yule and Co. to accept the position of Commissioners for three years was agreed to, and the work has since been carried on by that firm with great vigour. The necessary funds were provided by contributions in money or in kind from the Indian Tea Association, various tea companies, and mercantile firms. In their report for the past twelve months, Messrs. Yule and Co. point out that whatever may have been the share of the Commission in bringing about the present improved state of the tea industry, "the steady, persistent effort to introduce tea drinking to the people of India has resulted beneficially in many ways. Not only has tea been placed in villages where previously it was unknown, but in many of the larger towns foreign rubbish has been supplanted by sound Indian tea. The foundation has thus, it is hoped, been laid of a demand which, although of slow growth, may be confidently expected to expand until India herself becomes one of the largest consumers of Indian teas." The operations of the Commission have covered an extensive area, embracing over 2,500 towns and villages in India and Burma, and all classes of society have been approached. Nearly 4,000,000 packets costing a pice (a farthing) were put into circulation during the year, and the figures for the various months are—August, 1,71,088; September, 2,03,580; October, 2,03,894; November, 2,10,155; December, 2,20,107, January, 2,30,983; February, 2,15,003; March, 1,99,310; April, 1,88,956; May, 1,93,402; June, 1,70,200; and July, 1,83,033.

The falling off during the later months is attributed to tea being now often bought by the consumer in larger quantity in preference to packets. Many small traders after a time apply for tea in bulk or tins. As the purchasers of pice packets are too poor to take more than one or two at a time, the total of 4,000,000 must be regarded as very satisfactory. There is also a growing demand for brewed tea, nearly a million cups having been sold. The number for each month is approximately as follows:—August, 38,574; September, 53,758; October, 49,869; November, 53,368; December, 53,758; January, 56,388; February, 59,084; March, 58,864; April, 56,726; May, 54,537; June, 54,608; and July, 57,869.

Considering the excessive heat of the concluding part of the year, the results are considered to be "distinctly encouraging." Moreover, the above figures by no means represent the actual quantity of brewed tea disposed of—accurate returns from the vendors being unobtainable, while the amount distributed free of charge is not included in the returns. On the occasion of the Coronation festivities, for example, 85,000 cups of tea were given to the poor of Calcutta. Appended to the report are numerous expressions of opinion on the progress of the undertaking. Messrs. Gow, Wilson, and Stanton, the London tea brokers, write: "The result of the work so far is most encouraging, especially as the pice packets and number of cups of tea sold during the past six months of the Commission amount to about as much as during the whole previous year. This seems to show that a market for Indian tea can be found among the natives of India, and we most heartily wish you every success in the sustained efforts you are making in this direction." Another well-known London firm, Messrs. William, James, and Henry Thompson, observe: "We note the steady improvement in sales month by month, and consider that you have now tapped the source of a demand which may easily exceed the hopes of even the most sanguine." The Hon. Mr. Acworth, Chairman of the Central Travancore Planters Association, refers to the steady monthly increase in the sale of pice packets as proving that the native "is learning how to brew tea for himself, and that he is also acquiring a taste for sound tea."

The Viceroy (Lord Curzon), the Governors of Bombay and Madras, as well as other high officials, have expressed sympathy with the objects of the Commission, and their best wishes for its success.

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FRIDAY, OCTOBER 9, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

INTERNATIONAL FIRE EXHIBITION.

The Committee of this Exhibition have invited a party of the members of the Society of Arts to visit the Exhibition at Earl's Court on Wednesday, October 14th (afternoon and evening), and inspect the exhibits, including those to which the Society of Arts medals will have been awarded.

The members accepting the invitation will also have an opportunity of seeing the historical pageant and modern fire service display known as "Fighting the Flames."

The members will assemble at 4 p.m. inside the Warwick-road entrance of the Earl's Court Exhibition.

A round of the exhibits will be made in three parties, and the exhibitors will be requested to be in attendance at their exhibits to explain or demonstrate their appliances or work.

Modern fire appliances will be demonstrated at the lake from 5 to 6 p.m. (long ladders from 5 to 5.30 p.m. and fire engines from 5.30 to 6 p.m.).

The demonstration in the Empress Theatre will commence at 8.30 p.m. sharp.

A few tickets still remain, early application for which should be made to the Secretary of the Society.

In all cases admission to the theatre will be provided as well as admission to the Exhibition.

Further information will be found in the notice in the last number of the *Journal*.

CONVENTIONALISM IN PRIMITIVE ART.

By Sir George Birdwood, K.C.I.E., C.S.I.

The Society of Arts is under most grateful obligations to Mr. Carl Lumholtz, the author of *Unknown Mexico*, and to the publishers of the book, Messrs. Charles Scribner in New York, and Messrs. Macmillan in London, for permitting the reprint in our *Journal* of the 21st August of the copious and fully-illustrated extracts describing the so qualified "primitive" designs used by the Huichols for the embellishment of the textile fabrics manufactured [not machinated] and worn by them.

Much attention has been directed during the past thirty years to "primitive art," by which its specialised students and expositors mean the so-called "art" of contemporary savages, exemplified by the mechanical figurations, often mere scrapples and scrambles of dots and lines, composing, with more or less coherency, the hideous and repulsive, however ingeniously contrived and dexterously wrought devices to be seen on the paddle blades of the New Zealanders, the smoking pipes, dance shields, and dance helmets, and charms [resembling the *nitchkies* of the Japanese] of the Papuans, and the like ritualistic "properties" of other still primitive peoples; devices which by no charity of æsthetic sensibility can be regarded as embellishing [bellus-a-m, from benulus dim: of benus = bonus, *belle*, "beautiful" "good"] and decorative [decus, "comely," "becoming," virtuous, &c.], and by no elasticity of technical definition can be classed as artistic objects; while they can be characterised as ornamental [orno-are, "to accoutre," "equip," "furnish," &c., possibly at root the Sanskrit *varna*, "colour"] only in the primary and strictly etymological sense, and, in the nomenclature of the arts, a strained sense, of that word.

The first call in the great Victorian revival of the decorative arts of this country to the study of them from the point of view of their natural genesis, or in what is, with absurd exclusiveness, claimed as the objective, or scientific manner, in contradistinction to what is, with equal bigotry, disclaimed as the subjective, or æsthetic manner, was, in the opinion of experts of the current school of ethnologists, sounded by the late Mr. George Harris, in his *Theory of the Arts*, published by Messrs. Trübner and Co., in two vols., 8vo., in 1869. It was a continuation and extension of an earlier work of his entitled *Civilisation considered as a Science*, and was intended to be followed by another work, entitled *Anatome Dianoetike* [compare the different uses of this word by Plato and Aristotle], in which man was to be considered, not in the aggregate, but as the individual thinking being. None but experts now know of these books; but Harris was a Barrister of the Middle Temple, Registrar of the Bankruptcy Court at Birmingham, and is well known to the legal pro-

fession as the author of *The Life of Lord Chancellor Hardwicke.* He was obviously a man of highly trained intellect, considerable classical culture, and scientific tastes of wide range,—having served as a Vice-President both of the Anthropological Society, and the Psychological Society, of London; and he is certainly one of the most original, learned, philosophical, judicial, sane, and suggestive writers on art, in the English language. As will have already been inferred, he, with Plato, treats of the arts in their broadest and deepest relations to man, and civilisation, and nature; and as having for their end and aim all that tends to develope in man a well ordered and noble mind and character; and while he fails to adduce,—no one was then in a position to adduce,—any fresh concrete and tangible examples in support of his "bookish theorick," he elucidates it with infinite subtlety and acuteness of argument, and cogency of conviction, and with all the symmetry and lucidity of literary exposition which mark the writings of scholarly, erudite, and well-practised lawyers. The fact is that while he collates everything in the arts with nature, he never once uses such phrases as "primitive art," and "savage art," nor once refers to extinct Tasmanians, extinguishing New Zealanders, Bushmen, Red Indians, and Esquimaux; or to the ancient Mexicans, whose mechanical architecture and sculpture is at least monumental and impressive, or the modern Japanese, whose hieratic art, as distinguished from their secular art, is still the detestable primitive "art," so called, of the Indian Archipelago, and Australasia; and all the more detestable in its archaicised Ainoan forms, because of their marvellously elaborated craftsmanship. It was therefore indirectly only that George Harris stimulated the ethnographical study of the arts, through the fresh emphasis given by him, at the right "psychological moment," so far as the United Kingdom was concerned, to the doctrine taught alike by Plato and Aristotle, and Kant and Hegel, of the supremacy of Nature as the universally determining canon of human thought and action,—that is of the art of all "invention," "composition," and "expression." "Meliora sunt ea quæ natura quam quæ arte perfecta sunt,"—and "Omnis ars imitatio est naturæ," are aphorisms that have been proverbial in the world of art from the days of Cicero and Seneca.

The direct and special impulse, indeed, to these new studies was given, at least in this country, by General Augustus Henry Lane-Fox [who on coming into the inheritance of his great-uncle, the second Baron Rivers, assumed the name of Pitt-Rivers]. We can all remember the impression made by his exhaustless collections of objects illustrating the evolution of human [mechanical] invention so long on exhibition at the Bethnal-green Museum; and when in 1883, they were removed for permanent custody to Oxford, one of the first practical results of the transfer was the publication by Mr. Henry Balfour, in 1893, of his admirable monograph on *The Evolution of Decorative Art**; followed up, at my request, on the 10th of April in the subsequent year, by his lecture before the Applied Art Section of the Society of Arts, which he more happily, because with absolute accuracy, entitled "Evolution in Decorative Art."

In December of the same year, Professor Alfred C. Haddon, Director of the Royal Irish Academy, published, as No. X. of their *Cunningham Memoirs*, his notable monograph, extending to 277 pages, with twelve plates, beside numerous illustrations in the text, on "The Decorative Art of British New Guinea." It is of the very highest scientific authority, and of profound interest to all students of ethnography, and human culture: while, for the particular use of art students, the facts collected in this monograph, and the conclusions from them arrived at by Professor Haddon, were in the following year embodied in his volume, published by Messrs. Walter Scott, in their "Contemporary Scientific Series," under the title of *Evolution in Art as illustrated by the Life History of Designs*;—a delightful book for the novelty of its matter, the independence of its author's views, and the unconventional manner in which they are expressed, and their suggestiveness, and one to be possessed by every student of art, and even cherished,—for all Professor Haddon's peremptory judgments "between plea and plea and stroke and stroke" in a high controversy, not of to-day, but of a past dateless [it began in Europe in the 5th century B.C.] as its future, and determinable only by the temper—or the distemper! of "the ruddy drops," "the sacred ichor," infused about the hearts of men,—and by each man for himself alone. The matter of this controversy cannot indeed be advantageously discussed within any scientific *temenos*† the gates of which are closed against Socrates [who was a sculptor] and Plato [who practised painting], and even Aristotle [who was a patron of art, and taught "the youth of Pella" to be a great patron of art], and closed fast against Phidias, who is reputed to have said that he owed all his art—as "fire answers fire,"—to the poetry of Homer, and the philosophy of Plato.

James Ward, in his *History of Ornament*, published by Messrs. Chapman and Hall, in 1897, does full justice to the strenuous endeavours of Professor

* On the 11th April [see *Journal*, 21 April, 1893] of the previous year, Professor Schulze, of Crefeld, lectured before the Applied Art Section of the Society, Sir Thomas Wardle being in the chair, on the "History and Development of Pattern Designs in Textiles;" illustrating, by means of a large selection of actual tissues, the permutations undergone by the historical decorative types of the Old World in passing through the manipulations of successive generations of man, and from country to country, over a period of 3,000 years. It is an invaluable paper, and should be in the hands of every student.

† As scientific research becomes more and more specialised, scientists would seem tending more and more toward an exclusive circumscription of the definition of the area of scientific contemplation. But the temple of science is one with the temple of God ["Domus Iovis sublimis in omnibus"]:—"Deus cujus hoc templum est omne quod conspicis;"—"mundi magnum et vorsatile templum."

Haddon, with the accomplished support of Mr. Balfour, to place the study of decorative art on "a biological basis," and the facts bearing upon their theory of the arts will have henceforward to be taken into the consideration of all students of systematic art: but this theory is pressed altogether beyond its proper application by those who would insist that when a conventional design has been traced to its origin,—or origins,—in the animal, vegetable, or mineral kingdoms, you have discovered the secret of the arts, that is to say the source of their beauty, in evolution.

There is no more art in the mechanical figurations of primitive man and contemporary savages, or even of men who have advanced to barbarism,—which is ever picturesque,—and of semi-civilised, and civilised men, than in the letters and numerals of their ordinary script; and most of the conventional "designs"—so qualified—of savages, are but meant to serve either as charms, or as crude hieroglyphs for the conveyance of information. Even the famous magical and religious symbols of Babylonia and Egypt, now known to have directly prompted so many of the artistic types of the Old World, cannot be said to be artistic in themselves, or indeed to have had any necessary, or other than an accidental, part in the assumed "evolution" of the beautiful types—

"How beautiful beyond compare!"

actually suggested by them. If the Greeks, who, as Goethe has said, "of all people dreamt the most enchanting dream of life," had not copied their "palmette" and "honeysuckle" types from the religious symbols, conventionalised at first hand by the Egyptians and Assyrians from the palm tree and the vine, and, again, from the lotus, they would themselves have devised these types direct from such natural forms of their own hills and plains and sea-shores, as the honeysuckle, the cockle-shell, and the cuttle-fish. The art of these consummate types has nothing to do with the stateliness of the palm tree [Odyssey, VI. 163], or the splendour of the lotus, or the sweet, winsome, modest grace of the honeysuckle, or the refinement of the curves of the cockle-shell—any more than with the abysmal monstrosity—in form, and texture, and action—of the loathly cuttle-fish. Their perfected loveliness is of "the vision beatific" that comes,

"Like angel's visits, few and far between,"

only to exceptionally gifted men, who materialise the "spiritual body" of the absolute "archetypes" of all pulchritude, and clothe them with a "natural body" of sensuous existence,—to be the world's wonderment and joy for ever. In brief, there is no such thing, certainly not in the narrow meaning of ethnological writers, as evolution in art. There is only individual, incalculable, and miraculous inspiration; followed, alas! invariably by collective and continuous degradation of the ideals from time to time revealed to, and realised by creative artists of the highest genius. A master-soul founds a great school, and gradually this school of at first enthusiastic and disinterested, and at last sordid and perfunctory imitators, undermines the vital force of his work, and vulgarises it to the vilest uses; until, after generations, or it may be centuries, another master arises to re-vindicate and renew it. Alternate exaltation to the brightest heaven of invention, and abasement to the darkest Hades of mechanical mannerism*, in some phase or other of "l'art nouveau,"—this, in the patience of the all disposing gods, has been the history of the arts in every country, including Greece and Italy, of Europe. There is overwhelming evidence in it of what ethnologists may be left to call "devolution,"—"from top of honour to disgrace's feet,"—but never a tittle of "evolution." Take the objects of Papuan art, illustrated in Professor Haddon's monograph, and those in Mr. Balfour's scholarly handbook, surprised as we may be by the cunning of their contrivance, and the manipulative skill expended on them, and prejudiced in their favour by the fact of their being for the most part of spiritual significance,—the moving principle and distinctive note of all the greatest art,—there is not one of them which is not frightful to look npon, and not only demoniac but demonic in its frightfulness. It is a profanation of the eyes to look upon them; and they have no association whatever with art, and their proper place is in the strictest seclusion of museums of ethnography.

The sense of art is universal among mankind. It is found in the earliest races of men, and, so far as the surviving proofs go, it was more developed in Palæolithic man, of both the "river drift," and "cave dwellings" periods, than in Neolithic man of either the "bronze" or the "stone" age; although the far more numerous remains of the bronze age show a very wide and familiar use of informative and symbolical, and, sometimes, of intentionally decorative conventional types of the mechanical order. The Esquimaux, who are believed to be a survival of Palæolithic man will, with a few scratches, figure a reindeer on a bone with all the truth to nature and all the artistic verve and flare of Landseer; while among all the remains of Palæolithic and Neolithic man there is not one that excites horror, or that betrays a trace

* "Ages elapsed ere Homer's lamp appeared,
And ages ere the Mantuan swan was heard;
* * *
To give a Milton birth asked ages more.
* * * * * * * *
Then Pope, as harmony itself exact,
In verse well disciplined, complete, compact,
* * * * * * * *
[his musical finesse was such,
So nice his ear, so delicate his touch]
Made poetry a mere mechanic art."
Cowper: *Table Talk.*

"On Mincio's banks in Cæsar's bounteous reign,
If Tityrus found the Golden Age again;
Must sleepy bards the flattering dream prolong,
Mechanic echoes of the Mantuan song."
Crabbe: *The Village.*

of those weird and convulsive contortions of line which characterise alike the decadent "art nouveau" of contemporary Europe, and the assumed autochthonous "art," so-called, of British Papua. I say assumed, for it may be reasonably presumed that all highly laboured ugliness, whether in informative, symbolical, or decorative types, indicates archaisticism rather than true archaism, or primitivism, and a state, not of "evolution" in art, but of natural decay and degradation, or, in the language of ethnologists, of "devolution." My own suspicion is that the Papuan devices, depicted by Professor Haddon, are all depraved and sinister deformations of aboriginally Indian types, transmitted in the train of Buddhistic missionaries, Mahometan traders, and Portuguese and Dutch navigators, and fillibusters, voyaging, to and fro, through the centuries, between Southern India and Ceylon, and Farther India, the Indian Archipelago, and China and Japan. The Portuguese, it may be added parenthetically, undoubtedly influenced, if they did not originally inspire, the fascinating, secular art—in flower and landscape painting—of Japan. It is quite distinct from the ritualistic fruit and flower painting introduced, as I believe, into China and Japan, by the Indian Buddhists. While, therefore, the æsthetic sense, using the phrase in its platonic meaning [*aisthesis ton theon*], is latent in every race of men, and goes back beyond men to the animal kingdom, and is inherent in the very constitution of the "well-ordered" Cosmos, it is only in favoured races, and the most highly favoured individuals of these favoured races, that this sense is instinctively self-moved,—impelled,—goaded-on, to reproduce the true artist's "passionate intuition" of his ideals in realities more or less closely, answering to that "wonderous patterne,"—seen only of the inner eye,—which, wheresoever it be,—

> "Whether in Earth, laid up in secret store,
> Or else in Heaven, that no man may it see
> With sinful eyes, for fear it to deplore,
> Is perfect beauty."

The Papuan devices figured by Professor Haddon are therefore interesting to the student of art as suggestive of the prehistoric, primitive, or, it may be archaic origins of the historical decorative types of the Old World: which again would all have remained to this day, dead, mechanical devices, even as these Papuan devices are, had not the quickening spirit of art breathed its healthful, and elevating, and refining life into them, and transformed their deformity into those exquisite creations in the pottery, jewelry, coins, engraved gems, and architecture of the Greeks of the 5th century B.C., which continue to this day to be at once the inspiration and despair of the craftsmen, the architects, the painters, and the sculptors of the whole civilised, *i.e.* Hellenised, modern world.

But the Huichol designs for textile decoration are beautiful, and embellishing, and, alike, in conception, in composition, and in purpose, ornamental in the truest and best sense of the word. The types of the designs are taken direct from nature, from the local fruits and flowers, and with the objects they represent, they are all prayers; the water-gourd and the water-lily, and, the patterns derived from them, being prayers for rain. The fact recalls the beautiful saying,—I am always quoting in the *Journal*,—attributed to "the Prophet of God" [Mahomet]:—"In this terrestrial Paradise, the Garden of God, every flower is an Alleluia!": and that other touching oriental thought in the 3rd verse of the hymn of the Greek Church, translated by Neale, "The Lord my Maker, forming me of clay," of calling on the flowers of Eden to make intercession with God on behalf of Adam. There is not a flower in India—India of the Hindus, that is not thus sanctified by some moving association or other with one or other of the immemorial gods of the country. These Huichol designs are advanced far beyond the stage in which devices are no more than informative signs, or magical charms, or religious symbols. In artistic quality of line and colour there is nothing to be compared with them in the whole range of the ritualistic devices of the Melanesians of Australasia, and the Xanthians of Farther India, the Indian Archipelago, China, and Japan; and as conventional textile designs,—at once savoury of the soil, and classical [*i.e.* worthy to be "classed" as art], they could not be better inspired, planned, or depicted. Compare for example the Huichol treatment of the "double-headed [Hittite] eagle" with that of the "frigate bird" of the Soloman Islanders, Fig. 7, p. 462, of the *Journal*, 27 April, 1894. The Huichol "Royal Eagle" is perfectly conventionalised, and is executed with something of the almost ferocious energy of the heraldic draughtsmanship of Germany, as it is to be found in the *Münicher Kalender*, 1895-1903. The "double headed eagle" of the Hittites, together with the "winged bull," and other seraph-beasts, of the Assyrians, travelled into Southern India long before the modern rediscovery of that country by the Portuguese; and the type of the "Hittite Eagle" may also have travelled Westward, on European coins, in the proud wake of the Spanish navigation, conquest, and colonisation of the Americas. Mr. Carl Lumholtz expressly states that the crown on, and between, each of the heads of the Huichol Eagle, is of quite recent introduction from Europe; and the thoroughness of the assimilation of this detail, that is of its subordination to local "motifs," models [isomorphs], and manipulations,—more complete than that undergone in every instance by the ancient Assyrian types in Southern India,—is of itself sufficing evidence of the natural force and independence of initiative, and of the originality of the inborn and inbred artistic sense and technical skill of the Huichols.

Any one familiar with the textile art of India will have been struck by the remarkable resemblance, in their general artistic physiognomy—dependent on similarity of material, patterning, colouring, and use—of the bags, cloths, ribbons, &c., of the Huichols,

as figured by Lumholtz, to the similar productions of Assam. There is an extraordinary generic likeness between the four Huichol pouches, figured by Lumholtz, and the Assamese bag [details of which will be found in the chapter on "The Knop and Flower Pattern,"—"Tree of Life" and *swastika* patterns,—of my *Industrial Arts of India*] presented by me, in 1902, to the Parsi New Fire Temple at Woking, on the occasion of the dedication in the cemetery there of the Wadia Mausoleum, and the bag held in the hand of Assyrian kings, as they are represented on the "Nineveh marbles," worshipping before the "Tree of Life." This is of direct pertinence in the present connection, as it serves to accentuate the fact of the unrivalled theatre offered by India for the comparative study of the vernacular decorative arts of the whole world. The country presents the most varied structure, in more or less independent geographical areas, within the vast outstretched peninsula so strongly, and so homogeneously, defined by the Himalayas and the Indian Ocean. Its climates are of every degree of hot and cold, and moist and dry, but all regulated by the force of the periodicity of the prevailing Monsoons. Its inhabitants are of every race and nationality and religion, and in every stage of civilisation, but all more or less subdued to the physical, intellectual, and moral type imposed on them by the ubiquitous and continuous operation, through 3,000 years, of the predominating social system of the Code of Manu. Lying athwart the routes of the ancient and modern overland and seaborne trade between the East and the West, and accessible to every conqueror, in the course of this trade, from Central Asia, and out of the Indian Ocean, it has been the arena of every form of commercial and political exploitation, gradually systematised, harmonised, and rendered self-consistent by the long-continuance, throughout the Middle Ages, of the easy-going supremacy of the Mahometans, and the strenuous administration, since the 17th century, of the English. The result has been an infinite variety of local arts, each racy by its soil' but all one distinctively Indian art, in the unity of the classical perfection impressed on them by the preponderating genius, as of "the yielding irresistible air," of the great historical race of Brahmanical Hindus.

I have written much on this point in the *Industrial Arts of India*. But behind these classical arts of India—objects that all artists class as art—there are other manifestations of the æsthetic intuition of the people seldom observed by Europeans, which should have a special interest for the students of art on a "biological basis." Such are the sectarial marks, aboriginally totemistic tattoos, largely reproduced in the *Industrial Arts of India* from Allen Moor's *Hindu Pantheon*; and the symbolical marks tattooed on Hindu women, and the so-called "drawings" [*kolam*, literally "beautiful" cf. Greek *kalos*] traced with the fingers in sand, and coloured powders, on the almost daily occasions of public and private rejoicing, on the threshold or door sill, of all Hindu houses. Sir Henry Trueman Wood tells me that some twelve years ago he saw in passing one morning through the village of Knutsford, in Cheshire, a decoration being treated in this manner on the door step of a house where a wedding breakfast was to be given. At such festivities in India a *torun*, *i.e.* cord, or ribbon hung with leaves and flowers, in rythmical alternation, is suspended across the lintel of every door*; while before the front door, as you approach it from without, the plank, or large slab of stone, or the beaten and smoothed earth, which constitutes its threshold, is decorated with a variegation of symbolical designs in sand and coloured powders; the effect suggesting the origin of mosaic pavements, and rugs and carpets of many colours, in some such practice of archaic antiquity. This mode of decoration in India is entirely a domestic art, hereditary in Hindu families on the female side only, and the designs used are of a dateless tradition. I never saw any systematic or responsible notice of these tattoo marks, and domestic "drawings," until my young friend, Mr. B. A. Gupte, recently published in the *Indian Antiquary* his papers on "Female Tattoo Designs in India," and on "Divali Folk-lore;" in the latter of which he reproduces a copy by Mrs. Gupte of the ritual design with which she decorates the threshold of their house at the time of the annual celebration of the Divali [*dipa*, a "lamp," cf. "dips"!, and *avali*, a "row"] the Hindu "Feast of Lanterns," held in the new moon of Kartik [corresponding at present with 28th–30th October] in honour of *Lakshmi*, the consort of Vishnu, and "Goddess of Good Luck and Prosperity." I reproduce a half-page, which might be extended to half a dozen pages, of these tattoo marks, and the copy of Mrs. Gupte's Diavali "drawing." Mrs. Gupte's draughtsmanship with her finger-tips, and a powder dredge, must not be judged by her drawing with a European pen or pencil. The two accomplishments, as every craftsman knows, are quite different. Moreover I, in copying Mrs. Gupte's pen copy of her own Divali "drawing" have done so with my own touch of fingers, and movement o wrist, for it would have been as fatiguing as unnecessary to reproduce her pen-copy in *fac-simile*. With these precautious warnings, I proceed to explain the tattoo marks and the "drawing" in detail.

The Tattoo Marks.

The black dot stands, 1—for a mole, as a protection against "The Evil Eye"; 2—for Chandani, the ethereal queen-consort of Chandra [*chand*, "pleasure," *chand*, "moon," *chandni*, "moonlight," *chandala*, the crescent ornament fixed between eyebrows of those attending marriages,† *chandi*,

* Compare Juvenal [of the marriage rites and customs the Romans], vi., 51-2, 79, and 227-8.

† I have forgotten the reference,—but a similar crescent ornament, "lunula," was presented to the official witnesses, "Auspices Nuptiarum," "pronubi," "pronexetæ," who assisted at Roman weddings. Compare also the crescent, "luna," borne on the shoes of Roman senators,—and Assyrian kings.

"silver," also an opprobrious disease, *chandul*, "smokeable extract of opium"] the Moon, as Deus-Lunus; and 3—Rohini ["the Rosy"], of the goldylocks, the favourite wife of Chandra; she being a personification of the 4th Lunar Mansion or Asterism, corresponding with the constellation Aldebaran of the Arabs, the Hyades of the Greeks; the day in June of the passage of the moon through this Asterism being that on which the Hindu astronomers [*i.e.* astrologers] examine the weather indications for the forthcoming Monsoon [*i.e.* "season" of rain]. This Asterism is also figured as an aerial car.

The crescent is Chandra as Rakta-pati, "the Ruler [patron] of the Night," and Tara-gana-pati, "the Lord [*padisha*] of the Hosts [gangs] of Stars."

The dot, with the crescent above it, or below, is Rohini as a personification of "the Evening Star"—Venus or other planet—tripping across the western heavens at sunset with Chandra; an emblem of conjugal felicity. Cf: *Aucassin and Nicolette*:

> "Little star I yonder see
> Stepping with the Moon thro' air,
> Nicolette is there with thee,
> My small love with locks so fair."

There are histories alike this of every Lunar Mansion; and they are not idle fables, but living and perennially enacting histories;—for in the common light of each recurring day the gods of the Hindus walk the green earth with true believers; and on the return of night the whole expanse of the starry heavens is filled, to its deepest depths, with the ever moving pageant of their devout, theologised, astronomy.

The straight line, tattooed between the eyebrows, is another protection against the Evil Eye.

The 5 dots are the 5 Pandava paladins who all loved sweet Draupadi; an emblem of fraternal harmony.

The nine dots are the nine planets—the waxing, full, and waning moon counting as three—influencing the destiny of mortals; and a most powerful charm against all injustice, injury, wrong-doing, and evil. As a talisman, it is borne in the form of a pectoral amulet, or a ring, the nine planets represented by nine gems, always the ruby in the centre, the others usually being the diamond, coral, topaz, pearl, emerald, sapphire, cat's-eye, and *gomed* [? red agate].

The next three figures are forms of the fish, as a symbol of woman. Compare the "Vesica Piscis" of Christian iconography and art.

The triangle standing on its apex, and the left-handled *swastika* [cf. ticket], are also specific symbols of woman. The corresponding male symbols are the triangle standing on its base, and the right-handled *swastika*.

The next ten figures are variants of the lotus, the throne of Lakshmi [*lakh*, "100,000,"—as in a "lac" of rupees, Laccadives, "lake," "lacquer,"—hence, 1 in 100,000, a mark of auspiciousness, of good luck, also "money," cf.: Latin, lucrum], the consort of Vishnu, and Goddess of Wealth, and Special Patroness of Women. This flower, not its bud ["knop"] is always a specific symbol of woman.

The figure below the 7th "lotus" is of a spindle, as a symbol of woman.

The figure named by the Hindus *mukat*, or crown, is "the peacock throne" of Krishna [from *krish*, "to plough," applied to rivers ploughing through the rich "black soil," *regur*, of Southern India, and as they reflect its colour, "black," and "dark blue," they are also called *Krishna* [corrupted as the god's name to Kistna, Kris, Kisn, Kitty, Kit, &c., *cf.* Cyrus = *kurios*, "Lord," and Christus, "anointed"], who was born as the moon entered its 4th Asterism [Rohini, above]; and is the darling god of Hindu women. Krishna is represented crowned — "over-hatted," — with his wife on his left, and his brother, Balarama, on his right.

The remaining tattoo marks are a few of the many similar representations of the gay and giddy *gopis*, or milkmaids, literally "cow"-girls, in whose society Krishna so greatly confused his wasted youth. And in Western India, especially in the agricultural districts of Gujerat and the Deccan, during the celebration of the Holi festival, at the time of the Vernal Equinon, Krishna is still to be seen, of any night, with his whole train of merry *gopis*, drest all in flowers, out on the green leas, dancing and chasing each other about, in the enchanting moonlight. Similar revels go on during the "dark half" of the 5th lunar month Shravan [corresponding at present with 16 to 23 August] in the magic chiaroscuro of the waning moon. Krishna's first introduction to the nine *gopis* [or seven, for they are impersonations of the planets, and also of the notes of music] was through accidentally coming upon them while bathing: when he caught up all their clothes, and climbed up with the load into the top of a tall tree [*Calophyllum inophyllum*?] by the river's bank. The first "Havildars Guard" of the *gopis* represents them clothed, and in their right mind; the second—all spitted on a skewer—stript, with their heads modestly averted from Krishna; while in the third their clothes have been restored to them, and the dancing [*ras-mandala*] is about to begin.

The Divali "Drawing."

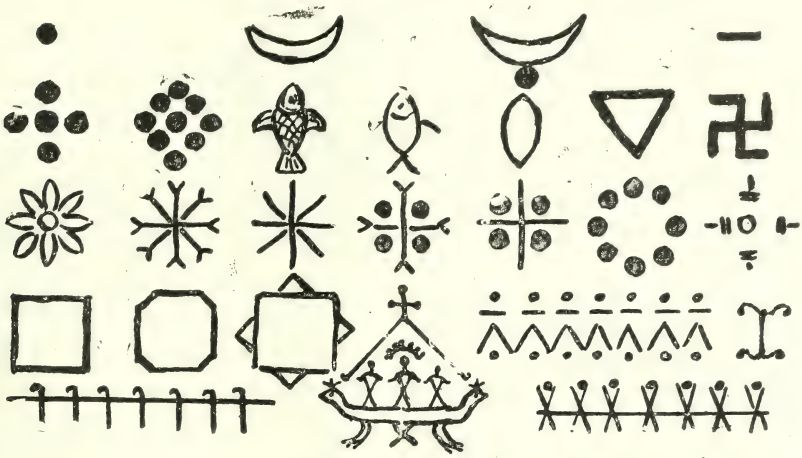
The design on the border may be varied at will.

The indenture at the near end on either side of the border marks the position of the jambs or door posts.

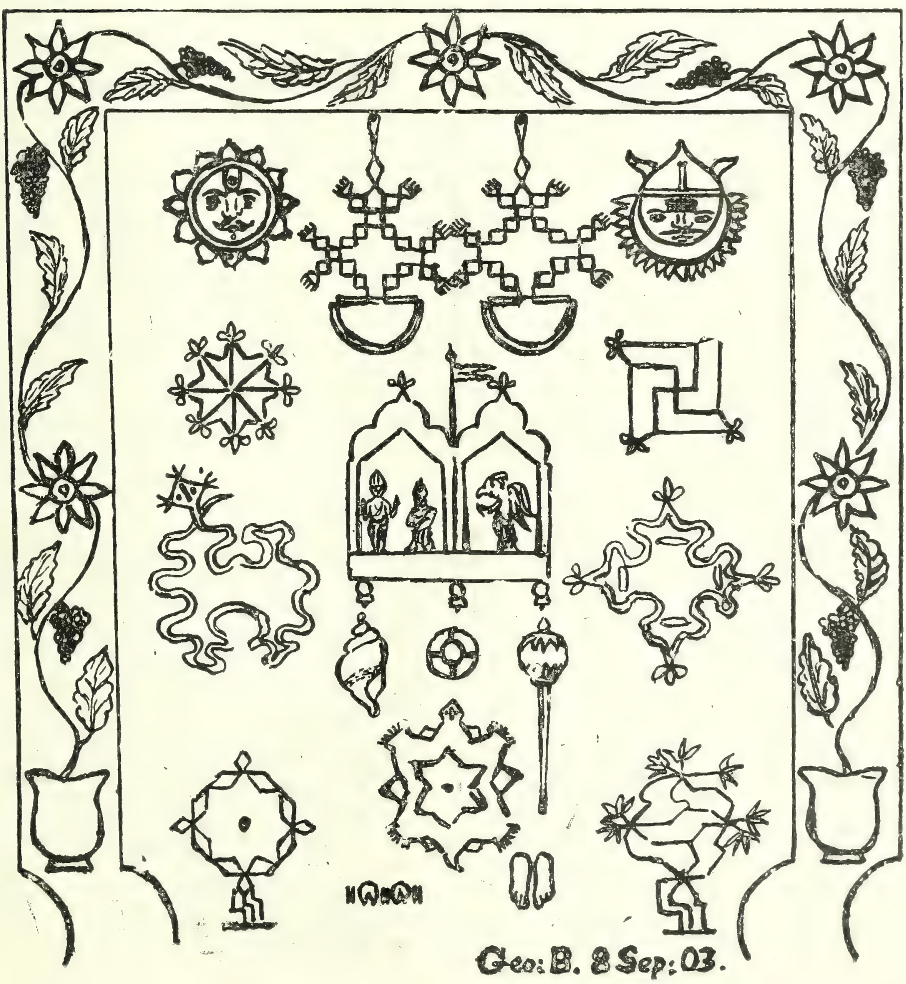
The face in the left hand far corner is Surya ["shining"], the Sun, bearing on his brow the sectarial mark of Siva.

The face in the right hand far corner is Chandra, the Moon, bearing the sectarial mark of Vishnu.

TATTOO MARKS ON HINDU WOMEN



ADIVALI DOOR-WAY DRAWI?G



The figures between them represent two hanging glass bowls of cocoa-nut oil, lit up for the Divali festival. The conventional manner of conveying the impression of their dazzling brightness is recondite and quite original; and would seem to have been suggested by the flashing facets of a rose-cut diamond.

The figure below the sun represents the lotus flower, and that opposite it is the all pervading *swastika* again; both, as already stated, symbols of womankind.

The snake-like figure represents the serpent Ananta, the "Infinite," literally "Without—[beginning or]—End," called also Sesha-naga, a symbol of Vishnu, and other deities.

The figure opposite it is one of the innumerable variants of it known by the name of "Krishna's Cradle," the endless permutations of which remind one of the children's game of "Cat's Cradle," as played 70 years ago in the nurseries of all Christendom.

The figure in the near left-hand corner is of the famous *Bael* tree, *Ægle Marmelos*, sacred to Vishnu, and to *all goddesses*. Mrs. Gupte gives it a hexagonal form, but I never saw it so drawn before, and in this copy I have rendered it as an "all a-growing, all a-blowing" octagon.

The opposite figure represents the well known mango tree, *Mangifera indica*, also sacred to Vishnu, and *all goddesses*, and a special symbol of the Spring [Vasanta], and introduced at all the festivals of the Hindu Cupid, Kama-deo:—

> "Can men resist thy power, when Krishen yields,
> Krishen who still in Matra's holy fields
> Tunes harps immortal, and to strains divine,
> Dances by moonlight with the Gopia nine?"

The temple in the centre is of Lakshmi-Vishnu; the Goddess being always named before her Lord in connection with the Divali festival. The bird-like figure in the right hand niche, represents Garuda, the *vehan*, or "vehicle", of Vishnu. Cf: Nisroch, "the great Eagle" of Isaiah xxxvii, 38, &c., and the Roc of the *Arabian Nights*.

The figure representing a tortoise should have been given a more geometrical expression by me; and it should have been placed immediately under the temple, which it is supposed to support; for the tortoise is supposed in the cosmogony of the Hindus to support—on the strength of its fecundity—the whole earth: and it is therefore that it is also a special symbol of woman.

The figures I have placed immediately below the temple, namely the Shell, the Disk, and the Mace of Vishnu should have been disposed on either side of the temple and tortoise.

The figures below the tortoise are, on the left, the marks of the "hebon black" hoofs of the milk-white Cow, Nandi, another symbol of fecundity; and on the right, the impress of the worshipful ivory white feet of Lakshmi.

By the side of the tortoise there should have been an energetic cock sparrow, a symbol of uxorial compliment-cy [cf: *Midshipman Easy*], figured as a cross between a bird and a left-handled *swastika*,—a fluttering *swastika* in fact,—but I left no symmetrical place for it.

The study of these tattoo marks and ritualistic devices seems to me to suggest at least two obvious conclusions. The first, that not only incoherent, almost amorphous, devices, but definitely formed symbols, when bald, and misproportioned, or slovenly, and slipshod, or in any way unseemly, are all illustrations of artistic decadence; and the second, that a self-consistent, regularly designed symbol having once been accepted by a people, their natural tendency is to wrest the familiar forms of nature about them to the canon of the established symbol, without any thought of endowing the later with the beauty of the former;—just as Procrustes stretched out, or chopped down, his captives to the length of his murderous bed.* Goethe has well said that the highest principle of art is significance, but he adds that the result of the right application of this principle is beauty; and this is achieved only through individual inspiration and technical magistery. As Pallas Athene sprung from the head of Zeus fully armed, so the work of every great artist passes out of his hands fashioned forth from the first to immortality, and without parentage of any "biological basis," or other pedigree than that of its divine descent. Lorenz Oken defined man as "the pantheistic animal." The phrase means more than the term Microcosm, when originally applied to man as the inexplicable compendium of the created universe, or Macrocosm. It means that man is not only the synthesis of the physical and spiritual creation, of all that is material and all that is individually spiritual [the *Karma* (—ego) of the Hindus], and therefore passing, but also of all that is divine, and eternally abiding [*Atman* of Hindus,—in Whom, not which, is the true *nirvana*† of all created personality]. In the physio-philosophy of the Zurich Professor, therefore, art in its highest definition is the symbolical reflection of

* Similarly Keble, the author of *De Poeticæ Vi Medica*, degrades his sweet gift of spiritual minstrelsy, above all

"The gift whose office is the Giver's praise,"

to the versification of "A Commination" and "Gunpowder Treason," from the *Book of Common Prayer*.

† European writers,—Sanskritists, philologists, and mythologists,—who have not lived in India, entirely misaprehend the *nirvana* by the Hindus, Buddhistic and Brahmanical: with whom it never means annihilation, but the absorption of the *Karma* into the *Atman*, in whose personality all created individuality is ultimately merged. But Wordsworth, the poet, clearly divines the spirit of the true doctrine of *nirvana*, and gives it final expression in his exquisite ode, "Intimations of Immortality from Recollections of Early Childhood":—

> Our birth is but a sleep and a forgetting;
> The Soul that rises with us, our life's Star,
> Hath had elsewhere its setting,
> And cometh from afar:
> Not in entire forgetfulness,
> And not in utter nakedness,
> But trailing clouds of glory do we come
> From God, who is our Home.

the design and ultimate purpose of creation as the probation of intellectual and moral beauty; and the artistic sense is the yearning latent in all men, to realise, each for himself, and for the world, the ideal which is the directing and operative "motive" of the visible universe. It is only in the noblest races that this sense becomes nascent; as, among the Hebrews, in their profound sense of holiness, among the Greeks of beauty, in the Romans of discipline and order, in the French of self-sacrifice for humanising ideals, and of philanthropy in the English; and it is only among the most richly and rarely endowed men of these generous races that this transcendental artistic sense becomes expressive,—in a Homer, a Plato, an Aristotle, a Phidias, a Julius Cæsar, a St. Augustine, a St. Francis, a Dante, a Fra Angelico,—while for the inarticulate multitude of men and women there remains, as their privileged participation in divinity:—

> "The desire of the moth for the star,
> Of the night for the morrow,
> The devotion to something afar
> From the sphere of our sorrow."

HEMP INDUSTRY.

A description of the hemp industry in the United States, by Mr. Lyster H. Dewey, Assistant Botanist, American Bureau of Plant Industry, has been published in the Year Book of the Department of Agriculture, from which the following particulars are obtained:—

The hemp plant (*Canabis sativa*) is an annual, belonging to the nettle family. It grows to a height of from five to fifteen feet, and when cultivated for fibre produces only a few small branches near the top of the slender stalk. Its leaves, of a rich dark-green colour, are composed of five to nine lanceolate, serrate, pointed leaflets, two to five inches in length and about one-sixth as wide. The staminate or pollen-bearing flowers, and the pistillate, or seed-producing flowers, are on separate plants, both plants being nearly alike, but the staminate plants mature earlier. The stems are hollow, and in the best varieties rather prominently fluted. The fibre consists of numerous series of long cells in the inner bark, firmly knitted together, which, when cleared from the surrounding tissues, form tough strands nearly as long as the entire plant. This is a bast fibre, and is classed commercially among the soft fibres, with flax, ramie, and jute.

The hemp plant originated in Central Asia, but it is now widely distributed, especially in the north temperate zone, growing spontaneously where it has been accidentally introduced with bird seed, or cultivated for the fibre.

The name "hemp" was first applied to the plant above described, but in recent years it has unfortunately been used to designate the sisal plant, or henequen, a species of agave producing a leaf fibre, and the manila fibre plant, or abacá, a kind of banana plant producing structural fibres in the leaf petioles. Sansevieria, a tropical genus belonging to the lily family, includes three or four fibre-producing species, often called bowstring hemp, and an East Indian species, *Crotalaria juncea*, is commonly known as Sunn hemp. The name is also applied to several other species of less importance.

Hemp fibre is long, soft, very strong, and capable of almost as fine subdivision as flax. It is especially adapted for use where strength is required. It is used in the manufacture of fine twines, carpet thread, carpet yarns, sailcloth, and for homespun and similar grades of woven goods. Nearly all of the best grade of long fibre, "dressed line," is used for making twines, yacht cordage, &c.; cheaper grades are made into binder twine. The tow is used for threads and for yarns to be woven into carpets, homespuns, and linen goods, and the refuse fibre combed from the tow is used as oakum for calking ships. The average annual consumption of hemp fibre in the United States is about 18,000,000 pounds, of which only about 8,500,000 pounds are raised in this country, the remainder being imported.

Hemp is cultivated most extensively in Russia, China, Japan, Italy, Austria, and France. The tallest and best hemp plants are produced in China and Japan, but the best grades of fibre are imported from Italy, where it is prepared by water-retting. It is not cultivated commercially for the production of fibre in the Tropics.

In the United States, the production of hemp is almost confined to Kentucky. Three-fourths of the American hemp fibre is produced in that State, in the counties of Fayette, Woodford, Jessamine, Garrard, Clark, Bourbon, Boyle, Scott, and Shelby. These nine counties are in the famous blue-grass region, of which Lexington, the principal hemp market, is the centre. The most important secondary hemp markets in this region are Nicholasville, Versailles, Lancaster, Danville, Winchester, Paris, Georgetown, Shelbyville, and Frankfort. Small scattered areas of hemp are cultivated intermittently in other parts of the State, and there are probably few counties in Kentucky, in which an attempt has not been made at some time to establish the hemp-growing industry.

There are two centres of hemp cultivation in Nebraska—Fremont and Havelock. During the past two or three seasons, about 100 acres have been grown at each of these places. In California, hemp is cultivated at Gridley, in Butte County. The industry has been gradually established there during the last half dozen years, and having passed the stages of experiment and loss due to new and untried conditions, there is now a tendency to develop and increase the acreage. Trials in hemp cultivation have been made on Ryers Island, near Riovista, in the Sacramento Valley, and in San Benito County. During the past two years, hemp has been grown

successfully on a small scale near Houston, Texas, and with improved methods of handling the crop it seems probable that it may become a profitable industry in that region. Hemp has been grown in the vicinity of Champaign and Rantoul, in Eastern Illinois, and along the Missouri River, between St. Joseph and Kansas City, but its cultivation in these localities has been almost discontinued, except at Rantoul, where about 400 acres are still cultivated each year.

Hemp is cut when the staminate plants are in flower. The time of harvest varies from 80 to 140 days from the date of seeding, the period of growth depending on the mean temperature and the supply of moisture, and on the variety. When sown at the proper season hemp is usually cut late in August or September (in July in California and Texas).

In some instances good fibre has been secured in Nebraska from hemp cut before flowering, but ordinarily the fibre is best when the crop is harvested just before the staminate plants are in full flower. If cut too early the fibre will be fine, but lacking in strength, deficient in yield, and wasting at every operation in its preparation. If allowed to become too mature the fibre will be coarse, harsh, and brittle.

Retting, or "rotting," is a process in which the vegetable gums surrounding the fibre are dissolved and the fibre is at the same time freed somewhat from the woody interior portion of the stalk and also from the thin outer cuticle. These gums are not soluble in water, but they are destroyed by a kind of putrefaction which takes place when the stalks are immersed for some time in soft water or are exposed to the weather.

Retting by immersing the stalks in water is largely practised in France and Italy, and it was practised in the United States until the middle of the last century, before hemp was so completely superseded by cotton in the manufacture of fine woven goods. Water-retted fibre is lighter in colour and finer in texture, and it commands a higher price than dew-retted fibre, but it requires a large amount of labour and expensive retting tanks. No process has yet been devised in America by which hemp can be water-retted so as to make it yield as great a profit as when dew-retted.

Investigations in Europe have demonstrated that certain micro-organisms are always present in flax when retting, and these agents play a most important part in the retting process. It is suggested that pure cultures of these amylo-bacteria can be made to facilitate the retting in much the same manner that fermentation is started in making wine and vinegar. In experiments conducted on a small scale flax was retted much more rapidly when the bacteria were supplied. The process of retting hemp is exactly the same as that of retting flax, and it is possible that by making use of the necessary bacteria the length of time and labour required for water-retting may be reduced to within the limits of profitable production. It seems impracticable, however, on account of the great bulk of the crop, to attempt to carry on the operation of retting under cover, as would be necessary in order to have the conditions under control. It may be possible to use the bacteria in a solution to spray on the hemp as it is spread for retting in the field.

Nearly all the hemp now produced in the United States is dew-retted. It is spread in long rows on the ground during the fall and early winter and exposed to the weather until the bark, including the fibre, readily slips from the inner woody portion. In Nebraska and California the hemp is spread in the stubble fields where it has been cut. In Kentucky it is usually spread in closely cropped blue-grass pasture land, and is sometimes hauled two or three miles from the hemp fields to the retting grounds. The plants are turned at least once to secure even retting, the tops being thrown over in the same manner as when turned in drying.

Breaking is the process by which the fibre is separated from the stalk and roughly cleaned. It prepares the fibre for market as rough hemp, and is usually the last operation performed on it by the farmer or hemp grower. The work of breaking begins as soon as the retted hemp is ready, and often continues until late in the spring. The greater part is broken during January and February.

Several machines have been devised for breaking hemp, but they have not given complete satisfaction. Very few of them have succeeded at all in breaking hemp in commercial quantities.

PARIS EXHIBITION OF DWELLING-HOUSES.

Although far from complete, this International Exhibition, in the Grand Palais des Champs Elysées, Paris, was officially opened on the 8th August, by the French Minister of Commerce, supported by officials connected with the departments of Public Instruction, Agriculture, the Colonies, and Posts and Telegraphs, while the President of the Republic was also represented.

The principal, and indeed the most interesting feature of the exhibition is constituted by six houses, actually built up full size, of suitable materials, the great object of the organising committee having been practically to demonstrate that hygienic and comfortable dwellings can be erected at a moderate cost.

The house of the Société d'Epargne des Retraites "l'Etoile du Foyer," a philanthropic and provident institution, contains—in the basement a wash-house and cellar; on the ground floor, a kitchen, 3·3 metres by 3·08 metres (10 ft. 10 in. by 10 ft. 3 in.), dining-room, 4·6 metres by 3 metres (15 ft. by 9 ft. 10 in.), and w.c.; and on the first floor, two bedrooms, 3·66 metres by 3·08 metres (11 ft. 11 in. by 10 ft. 3 in.), and 4·75 metres by 4·4 metres (15 ft. 6 in. by 14 ft. 5 in.), with a dressing-room. The price of the whole is quoted at 7,500 francs (£300) net for cash; but, reckoning the sinking fund at 5 per cent.. and nterest on capital at 3 per cent., the cost may

be paid off in 20 years, at the rate of 50 francs (£2) per month. This house, and also that about to be mentioned, were designed by M. G. Lavirotte.

The workman's dwelling, 3,500 francs (£140), contains (all on the ground floor) a vestibule, a common room, 3·25 metres by 3 metres (10 ft. 8 in. by 9 ft. 10 in.), with (outside these dimensions, and screened off if desired) a kitchen, scullery, and baker's oven, besides two bedrooms, 2·35 metres (7 ft. 8 in.) wide, one being 3·5 metres (11 ft. 5 in.) and the other 3·35 metres (10 ft. 11 in.) long.

The maison de famille has been put up, to the design of MM. Umbdenstock et R. Bouvard, by the workmen's societies connected with the Chambre Consultative des Associations Ouvrières de France. It contains—on the ground floor, a vestibule, kitchen, and w.c. with separate entrance; and on the first floor an antechamber and dressing-room, with three bedrooms, one 2·75 metres by 3·70 metres (8 ft. 11 in. by 12 ft. 1 in.), one 2·30 metres by 2·45 metres (7 ft. 6 in. by 7 ft. 11 in.), and one 3·75 metres by 2·75 metres (12 ft. 3 in. by 8 ft. 11 in).

The maison démontable, designed by M. Benouville, is constructed with double walls, the space between them being utilised as cupboards, and it consists of kitchen and common room on the ground floor, two bedrooms and bath-room on the first floor, and also three attics and a small loft. The price of each house, built in series of six, is 10,000 francs (£400).

A shooting-box is built in the very original style of M. Guimard, who designed the entrances to the stations of the Paris Metropolitan Railway.

The modern house, occupying a site of 8 sq. metres (9 sq. yards), designed by M. Charles Plumet, has been built by M. Parizy entirely of asbestos bricks, and contains—on the ground floor, a large common room, with kitchen and conveniences; and on the first floor, three bedrooms, with bath-room and w.c. The price (including bath and heater, with pipes) is 18,000 francs (£720). All the houses are fully furnished, ready for occupation; and, in the present case, the prices of the furniture for the three bedrooms are 700 francs (£28), 530 francs (£21 4s.), and 310 francs (£12 8s.).

The asbestos bricks, of which this last-named house is built, are called "briques amiantines ou amiantolithes," which can now be made at a moderate cost owing to the large deposits of asbestos that have been found in Canada. They have the great advantage of being absolutely incombustible and unattackable by acids, while at the same time being bad conductors of sound, heat, cold and electricity. They are composed entirely of asbestos, lime and silica in strictly defined proportions; and the substances, intimately mixed by special machines, are compressed in the form of ordinary bricks by powerful presses. The bricks are afterwards subjected to the chemical action of high-pressure steam, owing to which a double silicate of lime and magnesia is formed. These new building materials, the structure of which is perfectly homogeneous, are said to be equal to the best clay bricks as regards resistance to crushing stress. They are easily cut with the trowel, and take mortar well, while the thickness of joint is reduced to a minimum owing to the perfectly regular form of the brick. The external appearance is that of dressed stone; and, as the bricks can be coloured unalterably while in the state of paste, they lend themselves admirably to polycrome decoration. They are produced by M.M. Féodor Boas et Cie, at Choisy-le-Roi, near Paris, the works, which may be visited by those interested in the subject, being capable of turning out 40,000 bricks daily.

The same firm holds a concession from the Compagnie Générale Française d'Asbestic of Lyons, for its application of asbestos to building. The asbestic, mixed in equal proportions with cement or hydraulic lime, is used for an outside coat, and mixed in the proportion of 2 to 1 of plaster of Paris for inside plastering, the only change in these operations being that the coat sets more quickly than usual; but it is necessary to mix the substances, dry, very intimately before the water is added. The advantages claimed are incombustibility (including the protection of rolled joints and iron floors from expansion and consequent lateral thrust), deadening of sound, absence of cracks and maintenance of temperature, so as to preserve the inside warmth in winter, and protect from outside heat in summer. One weight unit of asbestic covers the same surface as 1·354 of plaster; and the additional cost, as compared with ordinary plastering, is very slight, considering the advantages offered.

A third application of asbestos to building is made by M. Coutillier, of Asnières, who supplies several Government Departments, and was awarded a grand prix at the Hanoï Exhibition of last year. This application takes the form of a tissue, and also of "slates," as they are termed, or rigid plates of very hard surface, employed for roofing, and also for outside coating or inside lining. In the first-named case it is stated that the duration is equal to that of zinc, at one-third the cost; and the plates are also lighter (weighing about 4 lb. to the square yard), while air, dust, and snow are kept out better than by any other substance. The aspect of a roof or wall covered with these plates in lozenge, or diamond, form is decidedly pleasing; and, being flexible, the plates lend themselves readily to covering an arched roof.

The use of compressed cork (under the name of "lidium,") for building purposes, is shown by a moderately-sized room, constructed entirely of this substance, in which it is stated that no binding material whatever is used, so that the non-conducting property of cork is preserved in its entirety, while those of impermeability and non-inflammability are given by chemical treatment. For lining structures formed of other materials, panels and flooring slabs are used, which latter may be laid directly, without a flooring of cement or timber. For the floors of bath-

rooms this substance is very cleanly and comfortable, while what are called *descentes de bain*, or mats for stepping upon on leaving the bath, are supplied as small cost by the Lidium Company of Paris and Saint-Denis.

A model (to 1:20 scale) represents the "Sunflower" house, which weighs in reality 800 tons, and is made to revolve bodily, so as always to present its front to the sun, by a force of 140 kilograms (308 pounds), in order to realise the physical law, that it is the light absorbed by substances which exert an action upon them, and that the chemical effect of light is in direct proportion to the quantity of light absorbed.

Notes on Books.

HANDBOOK OF COMMERCIAL GEOGRAPHY. By George J. Chisholm, M.A. Fourth corrected edition. London: Longmans, 1903. 8vo.

This work was first published in 1889. It is arranged so as to deal (1) with the general facts relating to production, distribution, and exchange of commodities—the climate, soil, labour, transport, instruments of exchange, &c.; (2) commodities dependent directly or indirectly on climate; fisheries, mineral products and manufactured articles; (3) countries. An attempt is made to deduce general principles from the results of statistical data. Statistical information is not alone considered, but the historical changes in trade and commerce are fully dealt with. An introduction to the present edition contains an account of the great changes which have occurred since the publication of the first edition, and the many causes which go to alter the whole history of commerce are discussed. The author treats of the difficulties of forecasting the future of commerce without due qualifications. The development of local advantages in the iron and steel industries in other countries, and the effect on the corresponding industries of the United Kingdom, are seen in a diagram which shows that Great Britain has completely lost its supremacy, and suggests a geographical cause to account for the fact. The effect upon the progress of the world caused by the immense increase of the electrical and chemical industries is also specially considered. The book is fully illustrated.

PRÉCIS-WRITING, FOR ARMY CLASSES, CIVIL SERVICE CANDIDATES, &c. Compiled and edited by H. Latter, M.A. London: Blackie and Son. 1903.

Various official correspondences on foreign affairs are here printed, with directions as to how the précis should be made. To the first item, correspondence relating to Ashanti, a précis is added.

Obituary.

MORITZ IMMISCH.—Mr. Immisch, who died suddenly on Sunday, 21st September, had been a member of the Society of Arts since 1884. It is stated in an obituary notice in the *Electrical Review*, that he was born in Thuringia, graduated at a German University, and came to London about forty years ago. His work was first directed to the art of watch and clock making, and in 1872 he obtained the Baroness Burdett-Coutts's prize for an essay on "The Balance Spring." He subsequently turned his attention to electricity, becoming one of the earliest pioneers in the development of electric power, and in 1880 he entered into partnership with the late Mr. Fritz Hubel. At their works was produced the "Immisch" motor, which received medals at the Inventions Exhibition of 1885, the Antwerp Exhibition of the same year, and at various subsequent exhibitions. After a time the Malden Works were closed, and Mr. Immisch retired from manufacturing work. Subsequently he was director of the Immisch Electric Launch Company, of which he was the founder.

General Notes.

NEWFOUNDLAND.—The area of Newfoundland is 42,734 square miles, its population 220,000. The minerals include gold, galena, iron, manganese, gypsum, copper, pyrites, sandstone, granite, petroleum, asbestos, mica, coal, chromite, marbles, lead, nickel, and roofing slate. Newfoundland ranks sixth in the list of copper-producing countries of the world. Its mines have been in operation since 1864, and have produced about 9,000,000 tons of ore. In the Bay of Notre Dame, a number of mines are situated at Tilt Cove, Betts Cove, and Little Bay. The Geological Survey of Canada Reports show that copper-bearing rocks are to be found spread over an area of 5,000 square miles. Practically, the forest resources of Newfoundland are untouched. The timber produced is spruce, larch, aspen, birch, balsam poplar, balsam fir, pine, ash, elm, maple, and fir. Some developments have taken place in the lumber industry within recent years, large holdings now being controlled by the British Lumber Company, Island Lumber Company, Lewis Miller Company, the J. J. Murphy Company, the St. George's Bay Lumber Company, and the Parrsboro Lumber Company. The annual value of the cod fisheries is about 4,500,000 dollars; seal fisheries, 600,000 dollars, although this spring's catch totals the enormous sum of 1,000,000 dollars. The salmon and lobster fisheries average annually about 1,000,000 dollars.—*Resources of B.N. America*.

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FRIDAY, OCTOBER 16, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

SWINEY PRIZE.

The Council have to give notice that the next award of the Swiney prize will be in January 1904, the sixtieth anniversary of the testator's death. Dr. Swiney died in 1844, and in his will he left the sum of £5,000 Consols to the Society of Arts, for the purpose of presenting a prize, every fifth anniversary of the testator's death, to the author of the best published work on Jurisprudence. The prize is a cup, value £100, and money to the same amount; the award is made jointly by the Society of Arts and the College of Physicians. The cup now given is made after a design specially prepared in 1849 for the first award, by D. Maclise, R.A.

Any person desiring to submit a work in competition, or to recommend any work for the consideration of the judges, should do so by letter, addressed to the Secretary of the Society.

The following is the list of the recipients:—

1849. J. A. Paris, M.D., and J. Fonblanque, for their work, "Medical Jurisprudence."

1854. Leone Levi, for his work on "The Commercial Law of the World."

1859. Dr. Alfred Swayne Taylor, F.R.S., for his work on "Medical Jurisprudence."

1864. Henry Sumner Maine (afterwards K.C.B.), D.C.L., Member of the Legislative Council of India, for his work on "Ancient Law."

1869. William Augustus Guy, M.D., for his "Principles of Forensic Medicine."

1874. The Right Hon. Sir Robert Joseph Phillimore, D.C.L., for his "Commentaries on International Law."

1879. Dr. Norman Chevers, for his "Manual of Medical Jurisprudence of India."

1884. Sheldon Amos, M.A., for his work, "A Systematic View of the Science of Jurisprudence."

1889. Dr. Charles Meymott Tidy, F.C.S., for his work, "Legal Medicine."

1894. Thomas Erskine Holland, D.C.L., for his work, "The Elements of Jurisprudence."

1899. Dr. J. Dixon Mann, F.R.C.P., for his work, "Forensic Medicine and Toxicology."

FIRE PREVENTION PRIZES.

At the request of the Executive Committee of the International Fire Prevention Exhibition, the Council of the Society of Arts offered, out of the funds of the Fothergill Trust, certain gold, silver, and bronze medals, for the best chemical fire engines and for the most easily worked long ladders exhibited at the International Fire Prevention Exhibition at Earl's-court.

The judges appointed by the Executive of the Exhibition have now nominated the following awards, which have been approved and confirmed by the Council:—

For 80 feet Long Ladders.

Gold medal to Messrs. Magirus, of Ulm.

Bronze medal to Messrs. J. C. Braun, of Nuremberg.

For Chemical Engines for Town Use.

Silver medal to Mr. W. Busch, of Bautzen. (Heavy.)

Silver medal to Messrs. Merryweather Ltd., of London. (Light.)

Bronze medal to Messrs. J. C. Braun, of Nuremberg. (Heavy.)

Bronze medal to Messrs. Sinclair and Co., of London. (Light.)

For Compressed Air Engine for Town Use.

Silver medal to the Kühlstein Wagenbau Gasellschaft of Berlin.

MULREADY PRIZE.

The Council of the Society of Arts offered, under the terms of the Mulready Trust, a Gold Medal, or a Prize of £20, for competition among students of the Schools of Art in the United Kingdom at the annual competition for the present year. The prize was offered to the student who obtained the highest awards in certain subjects—all life studies. This prize has now been awarded to Thomas Corrie Derrick, of Queen's-road School of Art, Bristol, who obtained the mark "Excellent" at the examination in drawing from life, a

Silver Medal award in the national competition for a finished drawing from the nude living model, and a book prize for a set of time studies from the nude living model.

The following is a list of previous awards :—

1884. To Charles J. Adams, of the School of Art, Leicester.

1892. To Laura Margaret Fisher, of the Clapham School of Art, Vernon-road, Clapham, S.W.

1893. To William J. Smith, of the School of Art, Leicester.

1896. Two students of equal merit having been recommended for award—the prize was divided, and a Silver Medal and Ten pounds awarded to Arthur A. Dixon, of the School of Art, Holloway, N., and to William N. M. Orpen, of the Metropolitan School of Art, Dublin.

INTERNATIONAL FIRE EXHIBITION.

The International Fire Exhibition at Earl's Court was visited by about 250 members of the Society of Arts on the invitation of the Committee of the Exhibition. The visitors were shown round the Exhibition in small parties, and the principal exhibits were explained and demonstrated by the exhibitors.

Modern fire appliances, consisting of long ladders and fire engines, were demonstrated at the lake in the afternoon.

The London Salvage Corps, by kind permission of Lieut.-Col. Fox, were drilled in the Western Gardens. The business of the day was concluded by a demonstration in the Empress Theatre, consisting of an historical pageant and modern fire service display known as "Fighting the Flames."

The party was received by Mr. Edwin O. Sachs, Chairman, and other members of the British Fire Prevention Committee.

Proceedings of the Society.

CANTOR LECTURES.

MECHANICAL ROAD VEHICLES.

By W. Worby Beaumont, Mem.Inst.C.E.

Lecture I.—Delivered April 27th, 1903.

"The spirit of the time shall teach me speed."—*King John.*

The history of the motor vehicle during the past seven years in this country has been interesting, but it has not been instructive, except to the maker and user. Most others have refused to be instructed, and their attitude towards motor vehicles has remained as stolid as that of the bucolic opposition to steam coaches in 1833, or to railways a few years later, and to the bicycle less than a generation ago

When I had the honour of giving the Cantor lectures on "Mechanical Road Vehicles," in 1895, there were but few makers of these vehicles, few users, fewer who knew much about them, and no makers in England. These things have changed very much since then; there are many makers, very many users. Many or most of the users are well-satisfied owners; and some believe they know more about what a vehicle should be than the makers do. Many of those who do not use them know that no one ought to be allowed to do so.

Easy and quick transport for man and things is as interesting a problem to-day as it ever has been, even although there is less to learn now than there was in the time of the English pioneers of three-quarters of a century ago.

A large part of the world is engaged in moving the other part, or in moving things for it. In fact, it may be said that nearly all the world gets its living by moving people, or things or materials of some kind—from the collier who moves coal from its resting-place to the Member of Parliament who moves a resolution that automobiles be numbered, and automobilists be hanged, or transported at some rate less than 12 miles per hour.

With apologies to Pope we may say, "Whatever is is best," in imitation of his limited truism. If he had lived to the present time he would probably have said, "Whatever is is best, but it would be better somewhere else." At all events that would not be an inappropriate motto for the maker of mechanical road vehicles, and Pope, if he were here now, and if the study of a machine be not detrimental to poetry, would probably give us a comprehensible eulogium on speed.

Shakespeare might have done something in this direction too, for he seems to have given some thought to speed gear, at all events he came to the conclusion that "to climb steep hills requires slow pace at first." He also made one of the leading actors in the troublous times of King John say, "The spirit of the time shall teach me speed," a sentiment which has ever since been accepted in principle and opposed in practice.

The modern advances, however, in the construction of the high speed engine have made

it possible to ignore the adverse influence of the steep hill, and since we have got the Act of 1896, by which some of the freedom to use our own roads has been restored to us, we now want the legal limits to speed removed in favour of such limits as expediency and mechanical laws alone prescribe.

Reverential regard for old nuisances prevents us from removing them even when it becomes possible, and hence we continue to allow uninformed and prejudiced legislators to introduce technical limits into a general Act, with about as much reason as there would be to prescribe limits in an Act of Parliament to the speed of a message through an electric cable, or of a railway locomotive.

No technical limits, no limits to dimension and invention should be permitted in a general Act, for the administration of which we pay the heavy costs of a Board of Trade, a Local Government Board, and a Home Department. The officials of these bodies are paid to be competent to frame and enforce reasonable and proper regulations having a mechanical or other technical basis; they are paid to possess, or to obtain, and to use technical knowledge in accordance with progress and the spirit of the times. These things they cannot do under Acts mutilated by prejudice, and full of the precautions against what prejudice conceives might happen.

It is well known by everyone here that the 1896 Act limits the maximum speed for a light locomotive, that is to say, a tricycle or a motor carriage, to 14 miles per hour. This is the one side-slip from righteousness in an otherwise excellent Act. It descends to detail, and that detail one upon which legislators had no experience. The Local Government Board reduced this to 12 miles per hour, and at this it remains in England, although the full 14 miles is the speed in Ireland. Of course, no one pays any attention to this speed limit when not in towns and villages except the magistrates in various bucolic districts, where by setting traps and fining automobilists generally the full imposition of an iniquitous law, they are able to relieve the rates of their district, and pay a large part of the cost of the police, whom they turn into skulking highwaymen, to the neglect of their proper duties in town and villages. The Surrey magistrates alone made, it is reported, about £500 from automobilists last year, not one of whom was even alleged to have done anyone any harm. They had travelled 63,561 feet per hour instead of 63,560, and were therefore fit subjects for enforced confiscation in aid of the district rates.

It is proposed that motor carriage owners should submit to the numbering of their carriage with very large figures. In order to obtain the repeal of the speed clause in the 1896 Act I would agree to this, but not as a clause in an Act. It should be a temporary regulation, under the powers of the Local Government Board. When we have got rid of the scorcher and inconsiderate driver this regulation could be rescinded.

When I gave the lectures in 1895 we were not only under the repressive enactments relating to road locomotives, but were restricted in our use of the lighter petroleums.

The freedom which had given France and Germany the leadership in one of the most pregnant industries ever fostered, was in this matter also denied us, chiefly owing to the hysterical regulations at the instigation of a few of those busybodies in Parliament who cannot be satisfied to do nothing, when there is nothing worth doing.

However, soon after the passing of the 1896 Act, the labours of a few in getting a common-sense view taken of the petrol question were successful, and another of the restrictions on industry, founded on the grandmotherly what-might-happen arguments, was swept away.

The whole of the makers, with few exceptions, recognised the superiority of the petroleum spirit for motor carriage purposes, and they still adhere to it for very good reasons. The old bogus talk of danger based chiefly on house lamp accidents has gone the way of other ill-informed talk. There is probably no undrinkable spirit handled so much and with so few precautions as are adopted with the assumed-to-be dangerous petroleum spirit, and yet the unintentional flagrations have been remarkably few.

Many of the objections to petroleum spirit on the part of those who as usual want to interfere and restrict have been based on ignorance. Because the spirit is volatile they think its vapour will behave like coal gas, not knowing that the vapour density is in excess of that of air. It is really a very docile well-behaved liquid, its most prominent fault being its high price in comparison with kerosene; but kerosene is much more difficult to use where the work is extremely variable; drops to zero frequently for a minute or two or more, and as suddenly rises to a maximum, as it does with cars in traffic,—circumstances

under which the presence of kerosene needs no advertisement. Under some circumstances kerosene is less liable to accidental ignition, although in many cases of its use the fittings employed are not sufficiently good to keep it from leaking or creeping about over every adjacent thing, and distributing itself by partial evaporation on the hot parts, but never effacing itself from anything on which it has been spilt or allowed to creep. Previous to the end of 1896 petroleum spirit could only be used carried or possessed in one pint capped tins, three only at any time.

The quantity of petrol that may be in the possession of an automobile owner is now limited to 60 gallons, whether that be in the tanks of the "light locomotive," or in storage tanks, or in two-gallon tins, in which quantity alone it is permitted to be conveyed. The size of tanks on the cars is left, and safely so, to the exigencies of the practicable; no maker or user will carry a large quantity of that which he can get very nearly anywhere on the road, and they may be trusted to use tanks that do not leak very readily, whether they carry 20 gallons or 5 gallons. Some of the accidents that have happened to tanks would equally have happened to a 2 gallon tank as to a 12 gallon. In fact we are doing much better now with regard to meddlesome restrictions, and shall continue to do so, if we keep on saying nothing for a time, except when some recrudescence of the intolerant porcine frame of mind again shows itself, and some legislator without occupation has the temerity to write himself up—by a name which will be readily supplied him.*

Although the Panhard and Levassor Daimler motor and the Peugeot Daimler motor cars had become known in France in 1894, it was not until the races of that year, inaugurated by the *Petit Journal*, that they attracted much more than local attention. When the Paris-Bordeaux races were inaugurated by that same spirited journal, in 1895, and the public interest taken in them there, was followed by well deserved and pregnant success, the English people began to realise more than ever how the viscous-brained opposition to the recommendations of the Select Committee of 1831, and to all road locomotion attempts since then, had robbed England of the industry which would naturally have followed the inventions of Gurney, Hill, Squire, Hancock, Church, and others, sixty years before, and of Blackburn, Holt, and Edward Butler, in the recent years; the last mentioned having been a pioneer in the design and use of petrol motors which ran at high speed, were well designed, and were fitted with an automatically variable float feed spray-making carburetter.

When then the success of the French motor carriage makers showed so clearly that modern inventions, materials, and facilities, would make possible an industry in mechanical road carriages, it became comparatively easy on the part of those interested to obtain the support of the Bill which ultimately became the 1896 Act.

The history of the beginning of the industry showed the importance of the part which may be played by the organiser of prize competitions. Although MM. Panhard and Levassor, MM. Peugeot Freres had early in 1896 a very considerable and real business in motor-car building, and Lutzman, Benz, Delhaye, Bollée, Serpollet, and others were also making as fast as means would permit; the industry was stimulated to an immeasurable extent by the organised races of 1894, 1895, and 1896. It was through these that England woke up, and at last contemplated her self-made fetters as things to be removed. The commercial side of the matter was a great stimulus, but the sporting element introduced by the races did a very great deal to popularise and encourage the support which the establishment of a new industry required.

It was not, however, in England alone that this popularisation by the races stimulated the designer, constructor, and commercial man. Americans had been free to make and to use mechanical road-carriages. Americans had not done it mainly for one reason. While we in Great Britain had the roads and were not free to use them, Americans were free to use them, but had not got them, or enough of them to make the light pleasure or touring or racing car of much use.

If we in England had not been denied the use of our roads, there can be no doubt that a great deal would have been done toward the realisation of the light steam vehicles now known; and in fact, judging by the experimental success which had been achieved by Yarrow and Hilditch, Holt, Blackburn, Neville, Grenville, Tangye, Mackenzie, and others, there can be no doubt about it.

It must always be remembered, however, that the steam carriage did not attract popular attention until after the Daimler motor in the

* Since the lecture was delivered many have so distinguished themselves in the daily Press, and a considerable number in the House of Commons.

Panhard and Levassor and Peugeot cars had shown what could be done with that motor and Levassor's arrangement of transmission gear. It was then that the steam car makers felt encouraged once more to persevere, and Serpollet's early successes were once more appealed to, and he and de Dion again entered the field. Serpollet left it some years, while tram-cars received his attention, but de Dion, Scotte, and others did their utmost with steam, chiefly with heavy tractors, wagons, and omnibuses. The Daimler petroleum spirit motor, however, and its progeny, rapidly monopolised the Continental motor vehicle field, and has even entered the heavy vehicle preserves previously consecrated to steam.

America entered the lists, but for some time its most noteworthy successes were obtained with electric cars and cabs, and there can be no doubt that having been provided by inventors of the old country with the secondary battery, America brought out the most original and the most favoured arrangement of framework and motor and gear. This, however, was not until after 1896, when the Riker and the Columbia Company and others, began making the form of electric carriage which prevails to-day. The American light steam carriage, in a successful form, also came afterwards.

We are thus driven back to this fact, that although the repressive and suppressive Locomotives on Highways Act was demonstrably a cause of delay of the motor carriage on the roads of Great Britain, it was the proved success of the Daimler cars, and of the French application by Levassor of the Daimler high speed petroleum spirit motor, that restarted the industry the world over.

Edward Butler had made a successful high speed petroleum spirit motor in 1884-85, and successfully applied it soon after, but was not allowed to use it. English magistrates, as usual, saw a thing that dared to be a new thing, and there something that must be killed, so they called his tricycle a traction engine and killed it. Daimler about the same time, or soon after, constructed his first high speed vertical cylinder motors, and in 1892 he built a car for export to the Sultan of Morocco. Daimler was free to make, try, and use cars.

The popular interest in motor carriages, however, commenced with the races inaugurated by the *Petit Journal* which did give the prizes it offered. Then the competition between the internal combustion motor and the steam motor on the long distances repeated year after year to the present time, developed the most remarkable combination of invention, skill, and materials the world has ever known.

The motor carriage builder attempted in some matters what the experienced engineer knew to be impossible with the materials employed. This was done in most cases by the amateur who dared, or who in ignorance attempted, what seemed to be a daring thing to the initiated. Failure, however, did not daunt him, and when his gear failed because it was too small for the material he used he did not increase size and weight as an engineer would have done, but called for better and better materials, then for better and better workmanship and better processes, until to accomplish his aims at strength, lightness, power, and speed, he has used and is using materials and workmanship that engineers would only of thought of using for the finest of standards or tools, or for the most costly apparatus of torpedo and gun work. He has called for these things until he has paved the way for the use of materials of extraordinary mechanical properties, and of machine tools and methods which will make the production of the best as cheap as that of the worst. Nothing but the best of everything could have accomplished the feats that have become common since 1896.

Just as the cycle maker persisted so has the motor carriage maker persisted, and he is doing to-day that which was absolutely impossible only a few years ago. He has stimulated the efforts of the engineer, the machine-tool maker, the metallurgist, the chemist, the india-rubber manufacturer, the textile fabric maker, and the coach-builder. He has, however, only been enabled to do this through the support of the rich purchaser, who, by indulging in a costly sport, has provided the funds which have made possible the development of the vehicle for the many and for trading purposes.

In 1896, the main principles and outlines of design of motor carriages had been formulated and materialised. From that time improvements have absorbed nearly all the efforts of designers ; experience has provided them with the subjects of their efforts ; day by day, the thing outlined by the few leaders has automatically taught the followers the requirements.

Those who knew all about steam boilers have found that they had a good deal to learn. Serpollet taught them a lot about the steam generating capabilities of a few feet of tubing,

and Whitney and Stanley have shown us how to propel a carriage with a tubulous boiler not much bigger than a hat-box. Boilers that could not possibly work because they would be filled with incrustation in a week, have worked, and are working with complete success, and do not fill with incrustation, whether they take water from the chalkiest country, or a village pond.

These boilers are heated by the largest burners ever made, burners 14 and 16 inches in diameter. They are in use nearly all over the world, and they burn that petroleum spirit which is supposed to be so very dangerous by those who are always harping on the what-might-happen. Some of the very people who employ these steam cars with these big burners, "because steam you know is so safe, and the steam engine so simple," were those who predicted most direful results of the spirit in motors in which the spirit was burnt in a closed chamber under pressure.

One highly respected journal, writing in June, 1897, said:—"As an instrument of sport, affording plentiful chances of sudden death from collision, upset, and explosion, the spirit car will satisfy the aspirations of any reasonable man, but it is just these capabilities which put it out of court as a commercial vehicle."

The same staid and respectable journal, speaking of the hypothetic owner of six brakes, requiring say 12 gallons of petrol per day each, said, "Where, he asks, not unreasonably, can I store what would be needed for carrying on my business?" and went on to say, "When the facts are put in this way we get an excellent idea of the practical objections which exist to the use of so dangerous an explosive. When we remember what a couple of gallons of paint made with a petroleum spirit did on board the *Scotia* we may realise the awful work that 100 gallons could do."

This sort of adverse criticism was rife from 1867 to 1900, and many of my engineering friends shook their heads in sorrow at my perverse encouragement of the motor carriage as then and thereafter to be made. Belief in my sanity was questioned when I said that a greater industry than the cycle industry would arise in the manufacture of trade vehicles of various kinds. One serious engineering journal said, in the summer of 1897, the year of the Paris-Dieppe race and the year after the Paris-Marseilles race of 1,077 miles:—

"The motor-car has yet to be made. It may be that it has not yet been invented. This we say with a full appreciation of what has been done in France. It must not be forgotten that what will satisfy our French neighbours will not at all satisfy public opinion in this country, which is much more exacting. And then after all comes the question—are motor-cars wanted? Will there ever be so full a demand for them that money can be legitimately made out of their manufacture?"

These illustrations are sufficient to show how much more dangerous it is to prophesy failure than it is to prophesy success of a thing is not inherently unattainable. Adverse criticism which dwells only on defects and difficulties, and the what-may-happen kind of troubles, is useless. Every maker of a new thing learns the defects soon enough, and especially when he enters trials, like the Paris-Marseilles and other races. He also knows the difficulties. Adverse criticism because of these things is no use, especially as it is almost always by writers who are ill-informed, and can only dwell on defects that have become obvious by the maker's efforts before the critic can know of them. The maker of a thing likely to be useful, or of a kind that is likely to be useful, wants that intelligent criticism that acknowledges achievements, and suggests the way to improvements, or out of difficulties. As a rule, the maker is indifferent to the conjured troubles that occupy the minds of the prejudiced.

The first exhibition of motor carriages held in this country was that organised by Sir David Salomons at Tunbridge Wells in October, 1895. There were exhibited then a 4 horse-power carriage by Messrs. Panhard and Levassor, the property of the Hon. Evelyn Ellis. This carriage was similar to that used in the Paris-Bordeaux race. One of these is shown on the screen now, and the next view shows the general arrangement of the gear. It will be seen that this car, designed by Levassor, and using the then V-type Daimler motor, covered in its main features the essentials of to-day. The wheel base of to-day is much larger, the gear is all enclosed in an oil-tight case, and the steering is by wheels instead of lever. Levassor covered his gear the next year though not in an oil bath, but the improvement in this respect was only adopting the oil-bath gear case used by English milling engineers.

Mr. Ellis had travelled on this 1895 Panhard-Levassor car from Paris to Havre, and from Southampton to West Malvern and the Cotswold Hills. From West Malvern to Gloucester, 26 miles, was travelled in two hours, the return

journey, which included a climb of about 800 feet in four miles, occupying three hours. Mr. Ellis found that the time occupying on a journey depended very much on the time of day. Early morning and Sunday travelling took about 50 per cent. less time point to point, because there were then so few horses on the road. The cost of running was under 10s., including lubricating oil for 120 miles, Datchet to West Malvern. The same distance would have cost much less but for the number of towns run through at very slow speed when the consumption was as great as with the highest speed.

At the same exhibition there was a carriage made by Peugeot Freres, with a $3\frac{3}{4}$ horse-power Daimler motor by Panhard and Levassor. The engine was placed behind the seat, but otherwise the general arrangement and the gear were the same as in the Panhard carriage. It was capable of ascending hills of 1 in 10 at, it is said, four miles per hour, and on the level its maximum speed was 15 miles per hour.

There was also at Tunbridge Wells a de Dion steam tractor with attached brougham or landau. This tractor was that seen by visitors to Paris in 1894, when it won the second prize in the Paris-Rouen race. The type has not survived. Two tricycles were shown, one an early de Dion-Bouton, the other a "Gladiator," with a $\frac{3}{4}$ horse-power motor. The de Dion weighed about 90 lbs. and the "Gladiator" 112 lbs.

The first exhibition of motor carriages in this country on a noteworthy scale was held in the Crystal Palace in the summer of 1896. It was known as the "International Horse-drawn and Horseless Carriage and Roads Locomotion Exhibition." The horseless carriages, as they were called, were not numerous, neither the Panhard and Levassor nor the Peugeot being exhibited.* Diplomas for medals were awarded to Delahaye, Serpollet, Thornycroft (steam van), Société Franco-Belge (steam brake), L'Hollier, Gascoine et Cie., and Arnold's Motor Carriage Company.

The Thornycroft van was totally different to anything now made by the Thornycroft Company. It was, as will be seen from the view now shown,† like so many efforts to make a motor vehicle, namely a form of horse vehicle to which a motor was applied—not a design for the purpose, and as a whole, and like almost all other vehicles of the time, it was not provided with sufficient power.

The following report was appended to the list of awards for vehicles exhibited in the exhibition. It was drawn up by the author as one of the judges, and accepted by all :—

"Although none of the vehicles exhibited approached that degree of perfection which would place them beyond the adverse criticism which condemns any evidence of an unrealised attempt, they (the judges) are of opinion that several of the vehicles shown and worked in the Crystal Palace grounds, have reached a degree of practical sufficiency, meriting some distinctive mark of appreciation.

"Most of the vehicles, which have stood the test of considerable hard daily work, were propelled by motors actuated by the internal combustion of light oils, such as benzoline. The use of these light oils in this country has been discouraged, although the cause of this is probably due more to fiscal, and to other restrictive regulations, than to any real evidence of danger attaching to it.

"Most of the carriages exhibited, and worked in the grounds, have motors supplied with hydrocarbon vapour, produced by the passage of air through some form of carburettor containing benzoline. This vapour, mixed with air, and compressed and heated by the incoming stroke of the motor-piston, was, with one exception, ignited by an electric spark, obtained by means of a secondary battery and induction coil. The one exception was the carriage of Peugeot, fitted with a Daimler motor, and lent by Sir David Salomons. This vehicle, however, did not come within our cognisance at the time of our visit with respect to the merits and awards.

"We have carefully considered the various points in the construction, detail, and working of the several vehicles and their motors, and we are very strongly of opinion that these benzoline motor carriages do, even in their present state of advance towards sufficiency, show that such motors may be practically employed for propelling vehicles of various kinds and for various purposes. The carriage of M. Delahaye showed a distinct step in advance upon the other benzoline motor vehicles; its double small horizontal cylinders, with opposite cranks and other details, including a very satisfactory tubular water-cooler, with simple force-pump circulator, freedom from escaping steam or water-vapour, and more power in a given space. He has placed before us a carriage which only needs the development to which experience will point the way.

These latter remarks pertain equally with regard to the steam vehicles exhibited and worked. The steam vehicles undoubtedly showed the greatest power, and the greatest flexibility or range of power. The ability to stop the motor, and start without

* Sir David Salomon's Peugeot was on view for a day or two at the end of the Exhibition, but was not entered for award.

† Cantor Lectures 1895, p. 24.

manual assistance, was seen to be a noteworthy advantage not only as a matter of convenience, but as a means of avoiding an otherwise very persistent vibration of the vehicle when standing.

"The steam carriage exhibited by M. Serpollet, although not of the maker's most recent form, is one which merits particular notice for its originality, its value as an indication, with a steam-boiler and engine, of the types used, its superiority with regard to range of power, and its exemplification of the advantages already referred to as to convenience in several respects.

"The steam van exhibited by the Thornycroft Steam Carriage and Wagon Company we also recognise as a very meritorious illustration of the most useful lines upon which arrangement and development of a most important class of motor vehicles may proceed.

"The Jurors considered it matter for regret that no electrically-propelled vehicle had been submitted for trial."

Although no electrically propelled vehicle was entered for trial in 1896, it should be recorded that a vehicle of considerable merit, especially as to its arrangement of gear, was designed by Mr. W. E. Clatworthy several years before, and made by the Acme and Immisch Electric Works, Limited.* Messrs. Thrupp and Maberly had also made several electric carriages.

Another exhibition of motor vehicles was held in 1896, namely, that at the Imperial Institute. Here were many of the vehicles, the fame of which had preceded them across the Channel. The Bollée tricycle was among the prodigies of this period. In a modified form it exists to-day, but in the hands of Bollée himself it was a remarkable performer. In this exhibition, and in the establishment of the Motor Car club, and in the starting afterwards of the Automobile club, Mr. F. R. Simms, who was the concessionaire in this country of the Daimler motor interests long before the motor carriage became so important a part of them, took a prominent part.

The year 1896 may be said to have proved the supremacy of the petroleum spirit motor for long distance carriages. In that year in the Paris-Marseilles race of 1,079 miles, the whole of the first places were taken by the Panhard and the Peugeot Daimler motor cars, the Delahaye, and the de Dion tricycle. In the following year the only steam vehicle that secured a place in the Paris-Dieppe race was the de Dion, and from that time to the present no long distance race has been won by any other than petrol motor vehicles. The Paris-Marseilles course of 1,077 miles was covered by the fastest car in 67 hrs. 42 min. 58 secs., or at a rate of 15·7, or an average speed of nearly 16 miles per hour. The second one, like that now shown, No. 8, did the journey in 68 hrs. 11 mins. 5 secs., or 15·8 miles per hour. After that there was no room for contention as to the suitability of the petrol motor. There remained only the work of improvements in details which has gone on ever since, the power having grown from the 4 horse-power and 6 horse-power of Panhard and Levassor and Peugeot respectively, to 70 horse-power and more, although the race has not always been won by the highest powers, and was not in 1896.

In November, 1896, the Light Locomotives Act came into force under regulations framed by the Local Government Board. On the 14th of that month, the then existing Motor Car club and a syndicate organised a great commemorative demonstration, and got together an enormous number of vehicles—French, German, Belgian, and American. All started from the Hotel Metropole in London, and most of them ran *viâ* Reigate to Brighton. The start and the progress through London and the suburbs, and near towns, was witnessed by a crowd such as had never before or since been seen in London.*

The first cars to arrive were two Bollée voiturettes and a Duryea car of a type which has not survived. It had a single cylinder, water cooled oscillating engine, with electric ignition, and the transmission gear included several belts. It is said to have done the journey in four hours, and the return journey in three and a-half hours.

There were among the vehicles several of the then most recent Panhard and Peugeot cars, and a new type of Daimler car, made at the Cannstadt Works, under Maybach's patents, which although a very comfortable and quiet-running carriage, has not survived, largely due to the demand for cars of higher power. This was the belt-driven car now shown.† Although this car is no longer sold, it was very much liked by several who owned them, and some are running even now. For a

* The gear arrangement was precisely that subsequently used in the Holtzer-Canot vehicle. The *Engineer*, 3 Jan., 1896, p. 4.

* *Autocar*, November 26th, 1896. *Automotor Journal*, November, 1896.

† *Society of Arts Journal*, see "Motor Vehicles and Motors," 1896, Paper by the Author, p. 108.

larger power, however, the arrangement was not suitable, and the rear position for the motor, has for good reasons almost universally been abandoned in favour of the front, just as it was first adopted by Bollée for his steam coach,* in 1885, a coach which possessed several features since much copied. With some modifications, this coach ran in the Paris-Bordeaux race in 1895, though unsuccessfully.

The commemoration run to Brighton did a great deal to awaken public interest in motor vehicles, and it was unfortunate that there was not a single motor vehicle manufacturer in this country who could accept orders for vehicles of the most successful types, for this gave the promoter an opportunity to draw money from the pockets of those inclined to speculate in establishing manufactories which were for various reasons not destined to be commercially successful.

Having now said so much respecting the events immediately following the Cantor lectures of 1895 and my paper in 1896, it is necessary to glance over the achievements since the latter year.

On one occasion when talking to an American tramway engineer in New York about the very large powers they were about to put into certain electric tram-cars, he said, in reply to my remark, "Well I reckon power is about the cheapest thing you can want, so if you want it you had better have it." There is a great deal of truth in this remark even as applied to motor carriages, although I think the time is returning when moderate speeds will become general. The fascination of very high speed cars for use in this country will have lost its edge, the racing car will stick to the racing course and the slower vehicle will meet the requirements of the majority of the vast number of those who will ultimately and chiefly for business purposes use the motor vehicle. Moderate speeds mean moderate power, especially as the time will come when most of country hill tops will be snipped off, and the materials put into the bottoms, or the roads will be diverted to more sensible contours. We shall never, however, go back to the very small powers of 1896 for two and four-seated cars. The greatest advance then has been in the power of the motors employed, the decrease in their weight per horse-power, and the decrease in the total weight of the vehicles propelled by them.

The 12 horse-power four-seated car to-day weighs less than the $4\frac{1}{2}$ horse-power Coventry Daimler car of 1897 or 1898, and when we see a motor capable of 16 horse-power, or even more, on a bicycle, we are inclined to wonder where the limit will be reached, and to expect that the machinery part of a motor vehicle will ultimately leave the designer of the most comfortable carriage unfettered by its requirements.

The greatest factor in the very great increase of power per lb. of motor is the very high revolution speeds which have become possible. Daimler's 650 revolutions grew to 750, and remained there, but the successful running of motor-cycle motors at 1,000, and even 1,500 to 2,000 revolutions per minute, emboldened makers to convert $4\frac{1}{2}$ horse-power by a stroke of the pen into 8 horse-power. The very high speeds for 8 horse-power single cylinder motors are, however, not without objections. These are chiefly made by those who wish their car to remain in order for at least a fortnight at a time, who prefer the car in their own instead of in the repairer's premises, who have a dislike to seeing every joint in their car-body shaken loose, and who object to some kinds of noises. There have, however, been some extraordinary cases of comparative longevity of the motors and the cars they are in, but on a general survey of the abnormally high speed question it is at present safest to conclude that a very moderate advance upon Daimler's 750 revolutions for a 4×5 engine is enough.

For the little giants used for bicycle purposes there seems no limit to the revolution speed, except that which becomes the terminal speed imposed by the ingress and egress of the gases. The parts are so light that they do not mind whether they are moved a little faster or not, a fact which reminds us that in reciprocating engines it is not piston speed that imposes a limit but revolutions of crank-shaft, or number of changes of direction of motion per unit of time.

The achievements by racing motor vehicles, or, as they may be more correctly described to-day, racing machines, are, even in the minds of those who have followed them step by step, little short of the marvellous. It is not long since it seemed impossible to get more than 10 horse-power on a vehicle weighing 1 ton. To-day we have 100 horse-power on a vehicle weighing 1,000 kilogrammes, or under a ton.

It is not long—not more than twenty-five years—since a learned professor, writing on limits to speed, made it appear (on paper) quite un-

* *Ibid*, 1900, p. 441.

necessary to attempt things that have already become possible on railways. To-day, the motor vehicle with wheels, tyred with the soft tread of the paw of a greyhound, are making rates on the common highway which are speed personified as compared with the dilatory diligence of the express trains of some railways.

The achievements of the motor vehicle have been due to the efforts of the unconvinced, as well as to those of the experienced, and these achievements will revolutionise the ways of the revolutionisers, who were led by Stephenson, Hackworth, Braithwaite, and Ericsson, and followed by the army of detail improvers to this day. They have not improved on the speeds of Brunel, and the demand upon them for more carrying capacity has been answered by the provision of larger trains, and more and more powerful engines to haul them. The time is coming for lighter trains, with less time between them, more power for a given weight, the heavy power and heavy trains being for goods traffic.

A return must be made to greater proportion of paying load to dead load, and much less than a ton per passenger must be sufficient.

On the speeds made by motor vehicles in the Paris-Berlin and the Paris-Vienna races it is not necessary for one to dwell.

Suffice it to say that in the latter race, an English car carried off the Gordon-Bennett International Cup, a car driven by S. F. Edge, and made by Napier, not the most powerful in the list, but with parts and driver of the best and toughest materials.

That cup is now to be fought for by England, America, France, and Germany in Ireland, in July next, and it is hoped it will remain where it is.*

The advances since 1896 include not only those of France and Germany and America. They include now those of the country which, though the greatest in engineering achievements, was enslaved as regards road locomotion by laws made by those whose gratitude for the blessings of railways and great steamships was only shown by attempts to make them unuseable.

These achievements in motor vehicles, include many matters of detail, which must be dealt with on another evening.

* The Gordon-Bennett race, run in Ireland on the 2nd of July last, resulted in a win for Cannstadt-Daimler, makers of the Mercedes cars, the winning car being a 60 horse-power car, driven by a Belgian named Jenatzy, and making sometimes over 80 miles per hour.

Miscellaneous.

THE GROWTH OF RATES.*

Dr. Ginsburg said that he desired, without attempting to deal with this question as a whole, to show the impossibility of raising, as was proposed, large sums of money from our provincial cities for the purposes of higher education. With this view the statistics of seven important towns—Birmingham, Bradford, Bristol, Leeds, Liverpool, Manchester, and Sheffield—were examined, and the area, population, rateable value, amount raised by the rates, and levy of rates per pound over decennial periods for the last half-century taken out. Liverpool, as being the nearest, and perhaps the most important, city, was taken as an example and its position discussed in detail. Comparing 1881 with 1851 it appeared that, though the population and rateable value had increased, the rates had also risen from 1s. 8½d. to 3s. 11¼d., so that the amount extracted from the ratepayers rose from £134,000 to £609,000 per annum. In 1901 it had further risen to 6s. 9¼d. in the pound, the increase over the amount of ten years previously having been 84 per cent. The movement of municipal indebtedness, not only for remunerative undertakings, but also for general purposes over the whole country, had also been upwards. The Local Government returns showed a total expenditure for all the municipalities of 88 millions in 1898 and of 121 millions in 1903 on reproductive works. The return which was made, however, by these undertakings was not proportionate to the capital charges incurred. Liverpool, for example, had spent 7¾ millions to obtain a return of but £45,000 per annum. The ancient sources of expenditure, such as the Poor Law, were not those upon which the present large outlay went. Housing, electricity, tramways, and education accounted for most of the increase. In the last ten years Manchester's contribution to the School Board had trebled, rising from £40,000 to £120,000, Birmingham's had risen from £73,000 to £134,000, and Liverpool's from £62,000 to £128,000. At a time when Manchester was paying 1s. 1 2-5d. in the pound for the Ship Canal and its School Board expenditure had risen to 10d. in the pound, whilst the outlay in other of the largest towns was from 1s. to 1s. 5d. in the pound, it was hardly suitable to embark on further expenditure, especially in the direction of Universities, for the buildings alone of a first-class University would cost a million—or 2s. 6d. in the pound on one of our largest towns.

* Abstract of a paper read by Dr. B. W. Ginsburg before the Economic Science Section of the British Association at Southport.

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Proceedings of the Society.

CANTOR LECTURES.

MECHANICAL ROAD VEHICLES.

By W. Worby Beaumont, Mem.Inst.C.E.

Lecture II.—Delivered May 4th, 1903.

In the year 1897, the motor vehicle industry had not really any existence in this country. It had, however, become firmly established in France and Germany, and the British were enthusiastic about the new thing at a distance.

After the passing of the Act, a number of manufacturers commenced to do what was unnecessary then, and what is hardly practicable now. They were not satisfied with the best results obtained by our friends across the Channel, and they were misled by the imperfect knowledge they possessed of the means by which those results had been attained. So they commenced to make a new engine or gear and car, or both, that should be, as they thought, better than the things made abroad. They most of them made scrap instead. A good deal of this was due to the misguided criticism that was frequent in this country, and some of it was also due to the fact that many who were accustomed to steam-engines and traction-engines, and also to gas-engines, imagined that the one thing needful was some simpler form of motor than that they saw either in the Daimler vehicles or the Panhard and the Peugeot, all, or most of them fitted with the Daimler motor. The experience of some years afterwards showed that although there was apparent complication in the governor gear and the apparatus for moving the exhaust valve, as it was found in the Daimler engine, the Panhard and others, the complication was more in appearance than in reality. At all events no engine has been found to run very much better, or continued to run better, than these engines.

In 1897 one more event to be noticed in connection with the industry occurred, namely, the establishment of the Automobile Club. It was an important event in this sense, that while it was independent of the industry it nevertheless enabled those who were to become interested in it to join a body which would organise things generally and make it possible for the results of English activity to be made known through the agency of useful forms of trials and tours. The club commenced its work by organising tours, and in 1899 it had made arrangements for the Richmond Show and some of the most important trials that had up to that time ever taken place, not excepting those which at that time were being and had been carried out in 1897 near Paris, trials which included those of the lighter and of the heavier vehicles. In 1898, numerous vehicles were put through very heavy tests, not only in France, but under the auspices of the Self-Propelled Traffic Association, which subsequently became the Liverpool Branch of the Automobile Club. There were also the trials of the Royal Agricultural Society, which were noteworthy as obtaining a highest award for a petrol motor van, one of the first of the Coventry Daimler make.

The results of some of these trials will long remain of interest, and as these lectures must be chiefly historical of the past seven years, I propose to deal briefly with them in connection with the different vehicles that will be shown upon the screen.

The first (Fig. 1) is one of the earliest Daimler motor cars manufactured in this country. After a good deal of experimenting, the Daimler Motor Company, of Coventry, made that vehicle, which is, to a great extent, the Panhard-Levassor vehicle of the time. It was a heavier vehicle and, in many respects, a stronger vehicle. I say, "in many respects" stronger, because it is not always that the greater weight means greater strength. Others of the same kind turned out by the company worked very well. They were fitted with vertical double-cylinder engines, with cylinder $3\frac{9}{16}$ in. diameter and $4\frac{3}{4}$ in. stroke, giving 5 to $5\frac{1}{2}$ horse-power. Some of the cars with trading bodies are at work even to this day. At that time it was usual to steer with a tiller-arm, as in many of the American cars to-day. The gear changing lever was placed on the top of a pillar in front of the driver, and moved as a horizontal quadrant — an arrangement made

by the Coventry Company, which, though not in accordance with that found in the "Panhard et Levassor" car, was satisfactory, and worked very well indeed.

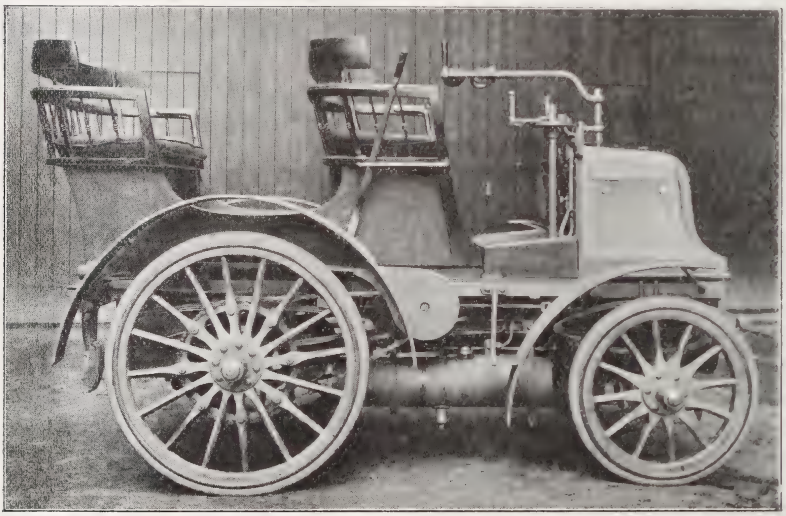
The petrol was carried in a horizontal cylindrical tank under the car frame. The tank was not quite filled, so that some space was left at the top part for a small volume of air under pressure, forced in by a bicycle pump. The slightly compressed air (a pressure of from 4 to 7 lbs.) used, forced the petrol to the carburetter and the burners for the igniting tubes then used, up a pipe which just dipped into a well at the bottom of the tank. The pipe was not allowed to dip to the bottom of the well, as the impurities and the water collected there.

At that time, also, it was usual, following the pattern of the ordinary carriage, to have the back wheels much larger than those used in front. Adherence to this feature became quite unnecessary with the adoption of the Ackerman axle.

The drawings now on the screen, Figs. 2 and 3 (p. 905), show the arrangement of the machinery. Although many of you are familiar with the features of this car, some reference must be made to them, because you will find that although great changes have taken place in various details, comparison with almost every car that is made with this, will show that the general principle of construction remains the same. The engine is a vertical one, a type fitted to about eighty per cent. of all the vehicles made. The crank-shaft is fore-and-aft, and drives through a bevil gear which is found in some of the best-known cars to-day. That gear which drives the transverse or sprocket pinion shaft runs in bearings which are connected to the driving-wheel axle by radius bars which maintain the proper distance between it and the sprocket pinions, so that the play of the springs, though varying the distance between the axle and the frame, leaves the chain length unaffected.

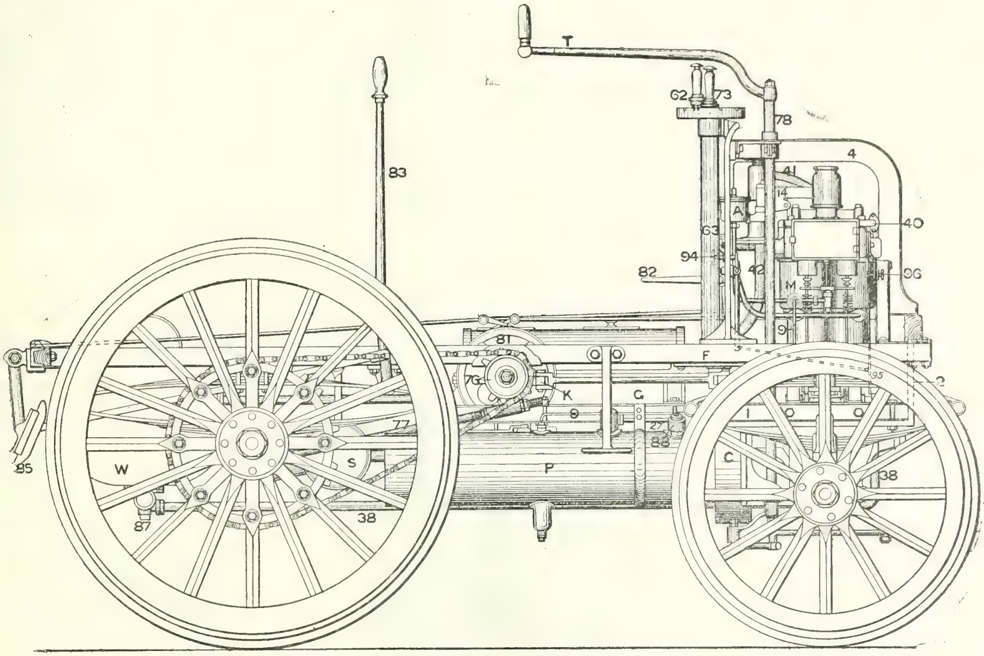
This next slide (Fig. 4, p. 906) shows the front of the same car, the Ackerman steering axle and the arrangement for cooling the motor by means of a semi-rotary circulating pump, worked by an eccentric. The charge in the motor cylinder at that time was ignited by means of the Daimler ignition tube, heated by the lamp at x. The next views (Figs. 5 and 6 p. 907) show the arrangement of gearing used in these cars for giving motion to the transverse sprocket pinion shaft. The crank shaft of the engine was coupled through the intermediary of a cone clutch to the gear-wheels on the sleeve 54, shifted by means of a fork in the groove 59, so that the wheels can be used for the slowest speed as shown, or for any one of four speeds. That arrangement worked very well, but improvements have been made in the design of

FIG. 1.



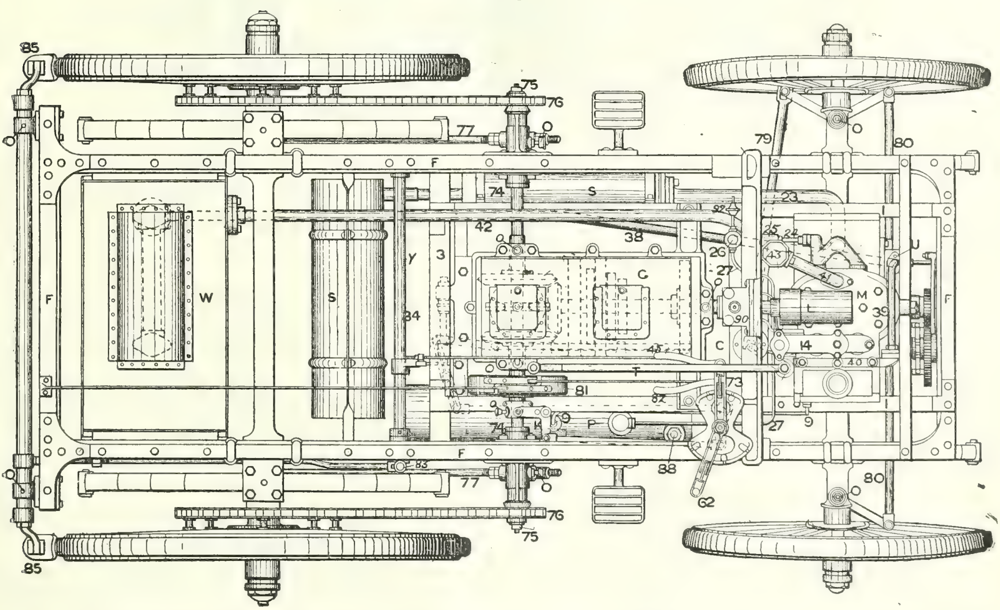
EARLY COVENTRY DAIMLER CAR, $5\frac{1}{2}$ H.P.

Fig. 2.



Early Coventry Daimler Car, $5\frac{1}{2}$ h.p.

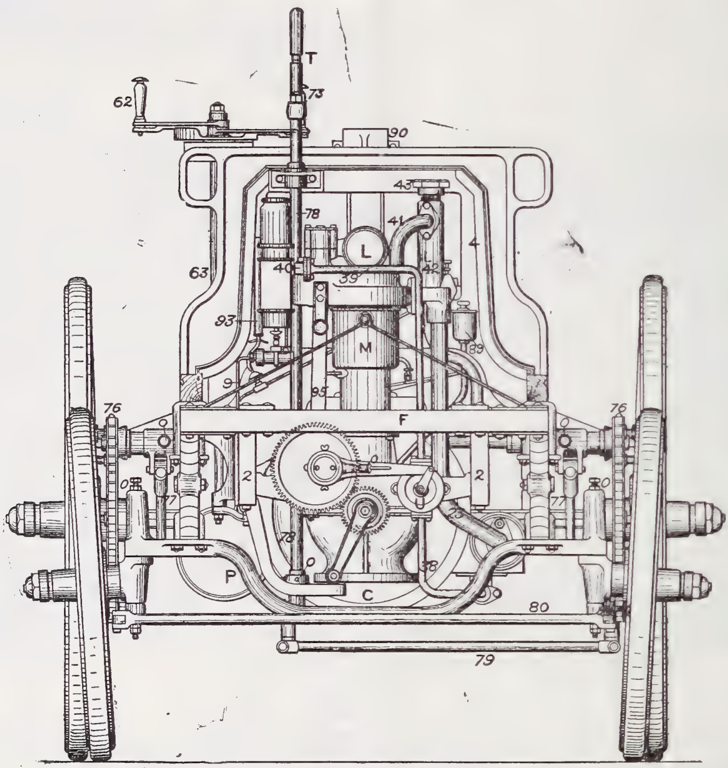
Fig. 3.



Farly Coventry Daimler Car—Plan of Under Frame and Running Gear.

the clutch, because the pressure due to the spring, 50, on the small surface on the end of the clutch shaft at 44, while the cone was in it place, and the clutch shaft revolving, and doing its work, was found to cause trouble by wear, and necessity for frequent adjustment. This arrangement of thrust block and spring has in most cases been modified now so that the thrust of the clutch spring is not visited upon the crank-shaft bearings, but is carried by ball thrust bearings, or is a balanced force cannot help looking upon as barbarous, except when the change of speed is made by stopping the gear and shifting it when at rest. In practice, also, it is a barbarous method, when not properly designed with reference to the requirements of its defects and when not properly used; but when these conditions are observed, this form of gear works perfectly well, or at least is what nature loves—a good working compromise. The chief difficulty with it arises from the inertia of the parts, the

FIG. 4.



EARLY COVENTRY DAIMLER CAR-FRONT ELEVATION.

not causing end thrust. In many cases it has been discarded in favour of cone clutches, in which the male part of the clutch is forced inwards instead of being pulled out, by a disposition of spring or springs, which enables the pressure on the internal and external cones to be balanced.

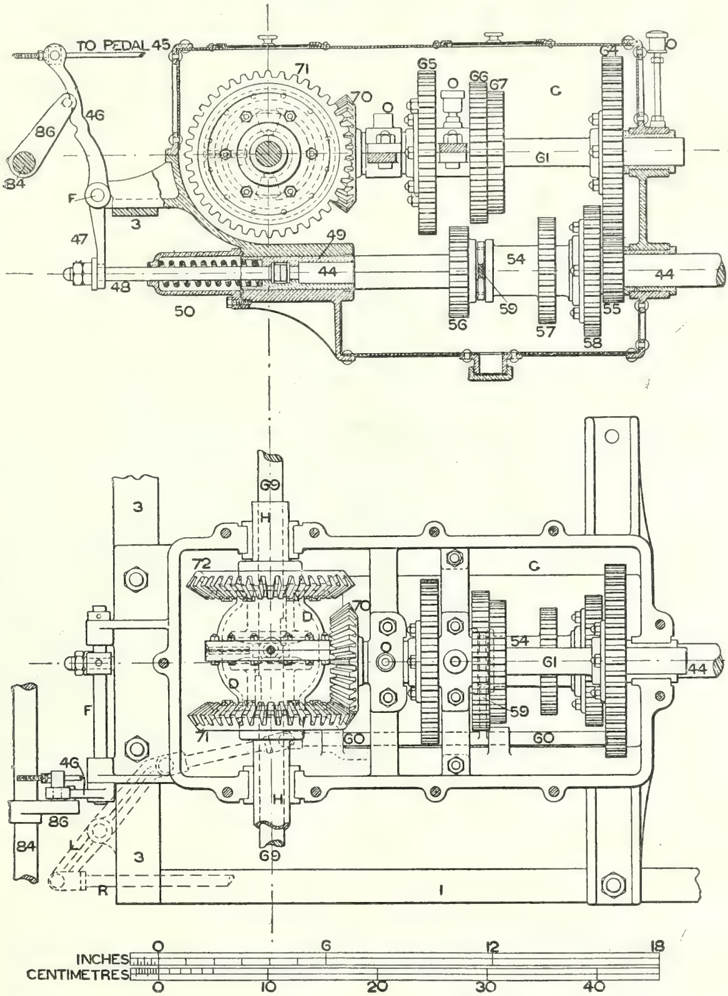
The changes of speed were effected precisely as in the Panhard-Levassor car, and in most of the best cars of to-day, namely, by sliding the gear wheels or pinions along their spindles, and so slipping the cogs into mesh sideways. It is a method which mechanical engineers

velocity of which must be changed at the instant the gear wheels slip into mesh while the clutch is out of gear. By keeping the weight of these parts down, and suitably rounding off the engaging ends of the teeth, and by giving the wheels such a proportion and pitch that the teeth are practically in line, the change from mesh of one pair to another can generally be made without any serious quarrel during engagement.

The Daimler Company exhibited some of these cars in 1899 at the Richmond Show organised by the Automobile Club; and a

very considerable number of vehicles were tested as to carrying power, and as to consumption, weight, and speed. These vehicles weighed about 18 cwt.; they had what was called a $4\frac{1}{2}$ horse-power engine; but by careful attention to several details in the engine — by the enlargement of the ports, increasing the space around the runs at an average of $11\frac{1}{4}$ miles an hour. No doubt they could have done more; but they were not allowed. We were very much afraid then of doing anything exceeding the twelve-mile limit, and competitors under the rules were not allowed to exceed the twelve-mile limit under pain of losing marks. One of these cars, carrying four people, did the fifty miles

FIGS. 5 AND 6.



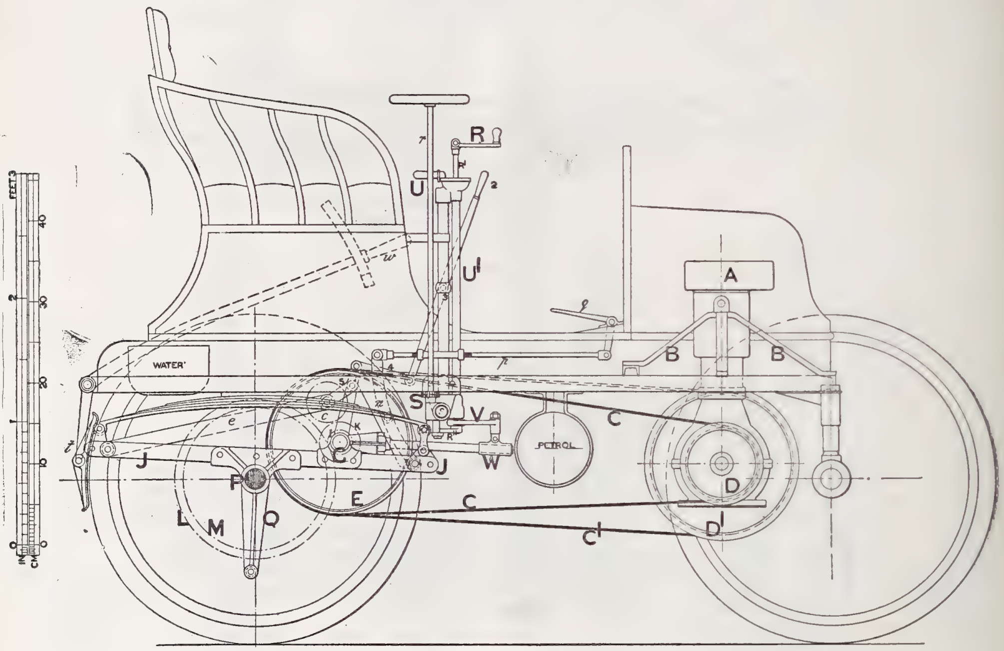
TRANSMISSION AND SPEED CHANGE GEAR—COVENTRY DAIMLER CAR, $5\frac{1}{2}$ H.P.

inlet valve for the ingress of the combustible charge, by altering the size of the discharge and getting more room round the exhaust valves for the egress of the burnt gases, the $4\frac{1}{2}$ horse-power engine rose to $5\frac{1}{2}$ horse-power, and with very slight enlargement of the cylinders, the engine reached 6 and $6\frac{1}{4}$ horse-power. That did not take very long. In the trials at Richmond these cars made fifty-mile with two and a-half gallons of petrol. A smaller car, with the same size motor, driven by one more accustomed to drive them, and who knew how to make use of down hill, did the fifty miles with one and a-half gallons of petrol; so that the difference in the consumption of some of the best cars to-day, and those at that time, even when the higher speeds of to-day are considered, is not so very great

For a time, the Daimler Company, who were then almost the only makers in this country, made only vehicles of this power. They afterwards turned their attention to making a smaller vehicle, because then, as now, there seemed to be a considerable demand for the lighter and cheaper vehicle. They made a 6 horse-power voiturette, designed by their then engineer, Mr. Critchley, and shown by Fig. 7, as one of the earlier efforts to produce a light car. They adopted the same size of wheel, fore and aft. The body was built to carry two passengers only, and the wheels were of the bicycle type. It was a belt-driven car, and it possessed several features of interest.

The engine was placed vertically and centrally in front of the car, between two belt pulleys, and the driving gear was all arranged on a form of bogy, independent of the frame, which was supported upon it by inverted springs. There were two belts for two speeds, and the change gear gave two more, the belt-driving gear being on a spindle, G, giving motion to the gearing on a live axle. For reversing, a wide pinion which is indicated at C, was dropped in between the gear wheels, K and L. The steering wheel was quite on one side, and the gear-shifting arrangements were brought out to the right-hand side of the car. The engine was carried by suspenders, B, on suspending pivots. Tie rods were used to adjust and hold the engine in position or pull it forward to adjust the tension on the belt. One of these cars was tested during the Richmond trials. Empty, it weighed only $6\frac{3}{4}$ cwt., and it attained a mean speed of $11\frac{1}{4}$ miles, and used $1\frac{1}{2}$ gallons for the fifty miles, so, as a light car, and upon these points of construction, it did very well, though the consumption was, as you will see, nearly as much as it was with the larger Siamese car shown by Fig. 1. The Daimler Company did not persevere in the effort to produce a light cheap car.

Fig. 7.



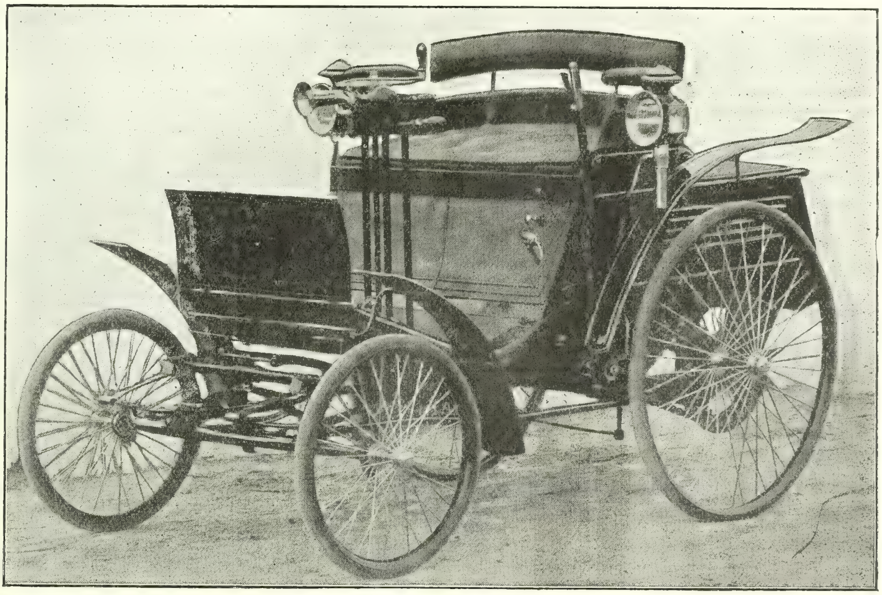
THE DAIMLER CO.'S LIGHT BELT-DRIVEN CAR (1899).

These are, then, some of the cars that were made until the end of 1899.

We may now look at one or two of the cars that came from the other side of the Channel in very considerable numbers. The car shown by the photograph, Fig. 8, is one of the Benz ideal cars, of which a very large number—more, I suppose than of any other—were then brought into this country, though most of them were in use only a year and a-half, or two years. They were less expensive than others, and they satisfied the requirements of those whose desire was rather to travel and see things, than to speed from one place to

another in the least possible time. Quite a number of these cars are still running. They had, as you know, single-cylinder horizontal slow-running engines. They had electrical ignition apparatus, and in careful hands gave very little trouble. The car shown had an engine with a cylinder $4\frac{1}{2}$ inches in diameter, 5 inch stroke, and ran at 400 revolutions per minute. The larger car, built by the same firm—a dog-cart pattern—was fitted with a double cylinder engine, with cylinders $4\frac{3}{4}$ inches in diameter and 5 inch stroke, running at 500 revolutions per minute. The speed, to a great extent, was dictated by the method of driving, namely, by means of belts. It will be seen that it is difficult—except with very large belts and very different diameters of pulleys — to reduce the speed of a high-speed engine to the low speed of the large driving-wheels which Benz always used, and at the same time to have a considerable range of ratios of road wheel speed to engine speed. Even with the engine running at only 400 revolutions per minute, the pulley 54 for the lowest speed (see Fig. 9, p. 911), is a very small one—although for the high speed the pulley 53 is a fair size; but if the engine, instead of running at 400 revolutions per minute, had run at 750 revolutions, the common speed with the Daimler engines of the time, this pulley would have had to be much smaller, and this would have made it almost impossible to transmit any driving power by it, there being no room for larger pulleys throughout. Even as it was it was necessary to run with belts rather tight, as the distance between the crank shaft and the sprocket shaft was rather small. The carburetter used was a form of surface carburetter*, something like, but not the same thing, as that originally used by Daimler, and one that very seldom gave any trouble. The engine was water-jacketed; but no pump was used for forcing circulation. In fact, the circulation was very slow indeed, but for the power given off the arrangements adopted were generally sufficient. The only inconvenience was a rather more frequent requisition at places on the road, for water. These cars were light. The "Ideal" weighed only about $6\frac{1}{2}$ cwt., was able to run 12 miles an hour, and at the early trials slightly over the twelve miles average was attained; the car carried two people, and consumed $1\frac{1}{4}$ gallons of petrol on the fifty mile journey. That was excellent then, and would be looked upon as good even now. Benz was one of the originators. He and Daimler were among those who should be remem-

Fig. 8.



The Benz "Ideal" Car, $3\frac{1}{2}$ h.p. (1899).

* See "Motor Vehicles and Motors."

bered with gratitude, as their brains and labour made the things which have developed into the subject of a great industry and great benefit to mankind. They were the men who made an industry possible; the heads for those who were not prepared to do the inventing and experimenting, or incur much loss of money or of time. Although the earlier forms of the Benz cars are not now being made, and although the Benz people have to follow, but not without originality, the changes dictated largely by fashion, Karl Benz and his firm should have the fullest recognition.

I have omitted to say that quite a number of early makers of cars—makers who gave the cars their names, or fancy names—all were using the Benz arrangement precisely, the engine, gearing, car, and everything. Some of them actually bought the motors from Benz, though the cars appeared under different names.

We come now to a new departure by the Decauville firm—that which was called the Decauville voiturette. It was one of the handiest little cars, and one of the cheapest brought out at the time. It had a single-cylinder, air-cooled motor, with electric ignition, and could be started from the driver's seat. The motor and its gear were at the rear of the car, and it had a live axle driven by three-speed bevil gear. It was awarded a silver medal at the Richmond Show and trials of the Automobile Club, and in the hands of some young expert drivers of the Decauville Works, it made some remarkable performances in gymkanas, where extreme handiness gave it great advantages. All its gearing was uncovered and exposed to the mud, dust, and dirt. Another defect of its arrangement—although its gearing was very ingeniously designed—was that in order to put the second speed into gear it was necessary to pass the third, by way of getting the second speed into position. So that there was often a very great deal of quarrelling in the gear; and, in fact, a spare pinion for this part was always sent out with a new car without charge. The car is well worth noting because of its originality and its influence on the designers of several of the cars since its birth.

The next car to be noticed is one of the Cannstatt Daimler cars, one of the original Daimler Company's, made at their works. It originated the Daimler-Maybach car.* They are now known as the makers of the celebrated "Mercèdes" car. At the Richmond Show and trials, there was one of these cars—although not the one here shown, but with gearing of practically the same arrangement. The car at the Richmond Show had a marine type of condenser used as a water-cooler. That was the first appearance of a car with what is known as the honey-comb cooler. It was provided with a fan so placed that it drew the air through the condenser or cooler, as was done by some earlier inventors for locomotive purposes. Other inventors had tried fans unsuccessfully for driving the air through condensers or coolers, but failed, for reasons which are sometimes matters of contention; but concerning which there can be no doubt. When we try to drive air through small holes, or to drive anything at certain speeds through passages, we run the risk of getting that effect which is well known in certain pneumatic work, as packing; namely, of getting the air, or liquid, or whatever it may be that the air may be carrying, blocked or packed up instead of passing through. There is a limit to the speed at which you can, under practical conditions, push a fluid through a tube. There is an analogy to be found in the action of sand in the sand-box, used for carrying the centering of an arch. Although the sand carries a very great weight, and could not be pushed through a hole in it, a very little effort indeed—in fact, hardly any would be necessary to cause the sand to flow through that box if you apply it by drawing away the sand from the hole. The same result is to be found if you try to force air carrying grain through a pipe; it will soon reach the limit at which it is possible.

The arrangement of the gearing of this car differed from that of the English Daimler car in many respects. The engine was carried on a frame separate from that which carried the body, and it was the first car that had a satisfactory countershaft pedal brake, though it was of a form which had been in use for a good many years.*

The next car of this date to which reference must be made is one by a maker who has, since its introduction, made a very great name in the construction of the fastest, as well as some of the best cars, namely, the "Mors." That car ran in the automobile trials, and did remarkably well. It was not long before some of its essential features were followed; and the main features were adopted by Mors for the next couple of years.

* *Society of Arts Journal*, vol. xliv., 1896, p 160.

* See "Motor Vehicles and Motors," p. 2027.

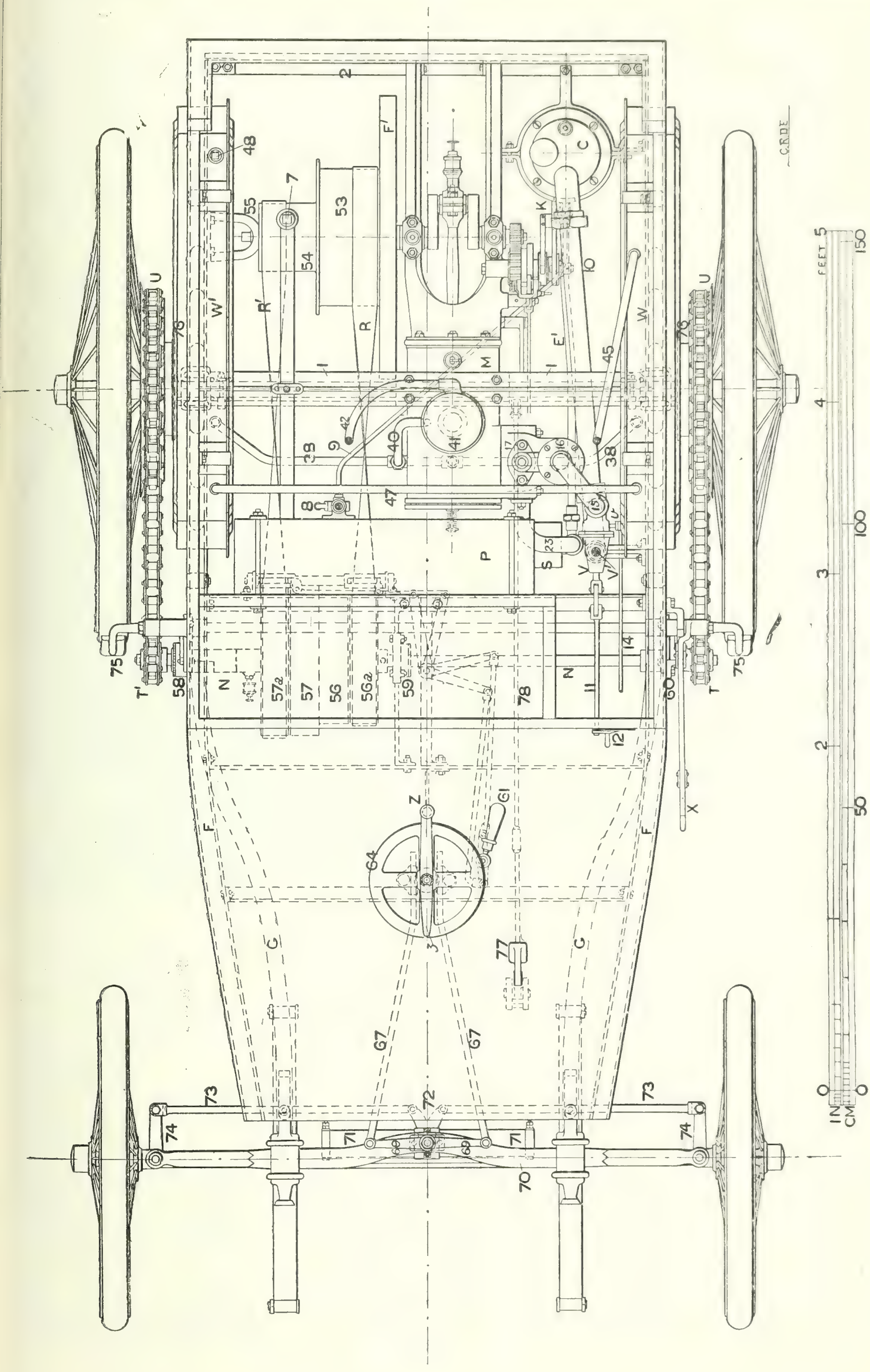


Fig. 9.—Benz "Ideal" Car-Arrangement of Under Frame and Running Gear.

The view before you shows the gear and engines as then used. This view is from a drawing produced with a very great deal of trouble. There was no drawing of the car complete at the time it was made from the car itself taken to pieces for the purpose. You see there the four-cylinder arrangement, the cylinders being at an angle from each other of about ninety degrees. They were fitted with the "Mors" arrangement of carburetter and they were at that time air-cooled. Till quite recent times the "Mors" firm had used air-cooled engines for these cars, but they put the cylinders side by side and in front. The arrangement of carburetter was a modification of that we generally call the Daimler-Maybach carburetter, but it was arranged so as to suit four cylinders. The ignition arrangements were in some respects, or altogether I might say, different from any of those of other makers. In fact, at that time, Mors was the only one using his arrangement. It was a belt-driven car, with two belts, both upon the same side, with a chain drive to the road wheels, and a cone clutch in the middle of the sprocket pinion shaft.

I must now move on to the next view (Fig. 10, p. 913), which brings us to a rather more important stage of the period we have to deal with, namely, one of the first very successful high-speed steam omnibuses of recent times. That is the Lifu omnibus, which was exhibited at Richmond, and ran through the trials, and which was also exhibited in the same year at Dover during the tests we had there under the British Association arrangement; and it was one which did a very great deal of successful running in different parts of the country. It cost a good deal for tyres on the driving wheels; but generally speaking it was a most successful omnibus. Like most of these things, beginning at that time, however, it was not altogether free from troubles with the steam boiler, although they were fewer in this case than with some others. The boiler was heated by what was known as the Lifu burner, one originally made by the same company for the heating of marine boilers, for the launches, of which they made a good many. Unfortunately the Lifu omnibus and vehicles were not made for any great length of time, certain difficulties having arisen owing to the death of the partner most largely concerned in it. The design of the Lifu vehicle has been largely followed since 1897, but as I have fully described it elsewhere I need not illustrate it now.

Another vehicle which has since been made on a large scale is the Thornycroft, one of the earliest of which was illustrated in this *Journal* in the paper I read before the Society in 1896. Since that time the Thornycroft arrangement has, as you will see, been very largely modified, and some of its features are to be traced in other vehicles. These views show the Thornycroft dust - collecting tip wagon made at this time.

The view now before you shows what was being done at this time by our friends in Paris towards the realisation of a practical vehicle of the heavier kind. It is a steam omnibus, and very well known indeed, partly because of the omnibus itself, and partly because of the omnibus trains run by the Scotte Company. In these, again, you see the vertical boiler in front and the chain-driving gear. The double cylinder engine drove a countershaft, by means of one chain; and this shaft carried two sprocket pinions driving the rod wheels by two chains. These French vehicles were all of them very heavy, and it was remarked by everyone, as a matter of surprise, that they should hold together as long as they did, and do so much work. They were heavy themselves and they carried a heavy load. The hind part of the vehicle had invariably a great overhang, and the speeds they attempted to make were excessive for such loads and such wheels. One can hardly be surprised that the success of the vehicles has not been greater, and not as successful as English vehicles for the purposes required in this country.

The view now before you shows the different arrangement of gearing adopted by another French firm—the De Dion Bonton, as used in heavy steam vehicles. They not only ran a good deal, and carried considerable loads at a rather high speed, but these makers claim to be the first to use the articulated driving arrangement for the driving axle.

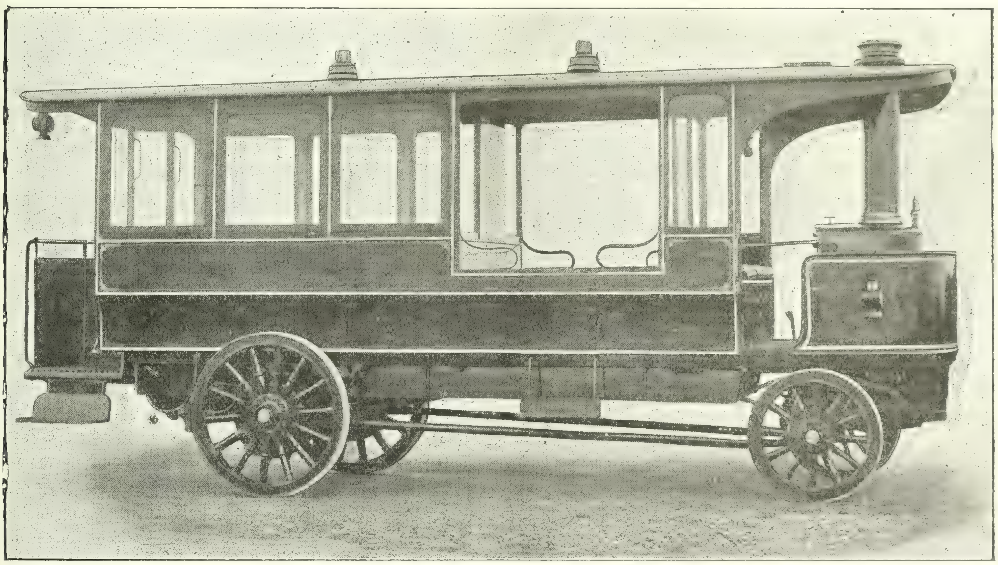
The engine used in this vehicle, as shown by the next view, was compactly arranged with shifting pinions between the crank shaft bearings driving the spur - wheels alternatively on a very short counter-shaft. Between these spur-wheels was the pinion driving the differential gear which, by the jointed propelling spindles referred to, drove the road wheels, and allowed for the play of the springs. The engine had a straight shaft, with crank pins in discs at the ends. This arrangement has much to recommend it with regard to shortness and directness of heavily stressed shafts, and it makes it possible to

combine the whole of the parts in one oil-tight case, carried so that there shall be no cross-stresses in spindles and bearings, and a similar design can be used when a chain drive is employed.

The next view recalls the omnibuses made by the well-known "Serpollet" firm. Here, again, we have the boiler in front of the vehicle. A rather heavy boiler it was, and not the light type which Serpollet uses now. The capillary tube has been given up, and layers of simple steel tubes are employed to form the boiler.

Steam vehicles for heavy work have made most progress, but the internal combustion engine is much liked. A heavy work vehicle which was, for the first time in this country, shown at Richmond, is now before us. That is one of the Cannstatt-Daimler vehicles. These vehicles have been improved in some respects, and are now known here as the Milnes-Daimler. One of these at Richmond carried a load of about two and a-half tons, and another a load of about six tons. They both performed their work extremely well, and they were awarded a gold medal. They were afterwards used in other trials, but, like most of the earlier vehicles with built-up wrought-iron spoked wheels, they were found weak in this respect. Nearly every one of the makers of these vehicles, steam or petrol, to begin with, dating from 1895 to at least 1900, ignored the experience of the agricultural engineers and the road locomotive makers. All those who made traction engines, steam ploughing engines, and the light locomotives now largely used, all who have done much in the construction of these vehicles, and of threshing machines, long ago found that to make traction wheels with light wrought-iron rims and bar spokes rivetted into them by one or two rivets, was to court failure. It has to be remembered that, when running over paved roads—especially with, perhaps, a total load of two tons, or at least 30 cwt. per wheel, at six or seven miles an hour—they were submitting rims and spokes to enormous stresses. They were carrying loads on wheels that were perfectly capable of carrying those loads on softer ground, but these wheels, from the very nature of their construction, were bound to go to pieces under the rolling-out action of heavy pressure, and the insufficient size and number of fastenings on the badly made granite pavements which act as anvils. Everybody has been long accustomed to the expanding of tubes under a rolling pressure in a boiler shell; they have been longer accustomed to changing the form by hammering cast-iron plates on one surface. For instance, when a cast-iron plate comes from the foundry, curled or bent, men of experience in foundry

FIG. 1.



THE "LIFU" STEAM OMNIBUS, 1899.

work have seen these plates straightened by lightly hammering all over the concave side of the plate. They have also seen the same thing happen automatically with tram plates. Precisely similar actions are brought into play when wheels are running over badly made roads, under a load of say thirty hundredweights on each wheel, and with the velocity of recoil of the spring-carried load. The result of the costly experience of the last few years on this subject has been a very general return to heavy wood wheels like those invented by Hancock and used by him seventy years ago, and now called artillery wheels. All makers have been forced to adopt the designs of the agricultural engineers and traction engine makers, a structure of wheel almost solid from axle to rim.

This view before you shows one of the 1898 vehicles carrying a very considerable load. Here, again, we have the maker going through the experience I have mentioned. This vehicle I have only put upon the screen to show you how money and time have been wasted by want of experience in the effects of heavy traffic work. The wheels you see on this vehicle would, by calculation not guided by experience, be amply strong for the work, but they were useless in fact. The view also gives you some idea of the improvements in general design and the carrying capacity of vehicles of that type when the 1898 vehicle of some makers is compared with that of to-day.

The next vehicle that will be put upon the screen is one of two years later date, and known as Straker's. It is a vehicle which is the outcome of that tried at Richmond. Originally it was known as the Bailey lorry, and was designed by Mr. Straker, and had a De Dion boiler and gear similar to that of the Canstatt-Daimler vehicles. As now made, it has a final drive by strong chain and intermediate shafts with strong spur gear.

You will see that nearly all the more recent vehicles have the engine and boiler placed as in the Lifu vehicle, and several of them have for the final drive spur pinions gearing with an internal wheel in the driving-wheels, an arrangement which is also the same as that of the Lifu. The gearing in most vehicles is thoroughly boxed in, so that the benefit of running with an oil film always between the surfaces is more easily obtained. The Table on page 915 gives the results of the trials at Richmond, in 1899, of the vehicles which received the Automobile Club certificates.

With regard to the road vehicles, mention may be made here of the tyre width question, and of one point which was settled during the War Office trials. The three-ton limit is one against which much has been said by some of those who think they can carry economically large loads on four wheels over ordinary roads and continuously. It is a very favourite argument—or statement—for instance, in the North of England, and particularly in Liverpool and in Manchester, that if they could get the three-ton limit altered, so that instead of three tons as the weight of a vehicle, without its fuel and water, they could get four or five tons, they would then be able to carry a load which would allow them to compete with other methods of carrying and enable them to secure better treatment from the railways. The notion that it will ever be an economical thing to conduct traffic on common roads over distances say of thirty miles, backwards and forwards continuously, on the same roads and between two points, carrying some thousands of tons per day, as is proposed should be done—economically and at such a rate as to make it advantageous as compared with railway methods—is I think a great mistake. The vehicles themselves must be heavy and costly, and when the loads to be carried reach eight or ten tons as is proposed, and the vehicle itself weighs four or five tons, then they are reaching conditions which make it impossible to maintain ordinary roads for the continuous passage of vehicles—carrying say over a thousand tons per day—unless they have a specially made road. Once you reach those conditions that make it desirable to run a thousand tons per day, between two points 35 miles apart, and you are satisfied that you can see traffic to that amount, then you have reached the conditions that apply to a tramway or railway, or perhaps one of the best forms of plateway. Put down one of these or a railway with plateway branches, and then, and then only, will it be feasible to carry and to distribute this heavy traffic by motor vehicles along, but generally not on, the ordinary highways.

We cannot on ordinary roads of macadam run with a load of three tons on the wheel without applying to the materials of the road precisely the same treatment as is applied in the pan of a mortar or grinding mill. If the crushing applies in one case, we must expect it in the other. To avoid its consequences it is necessary to make the wheels of great width, of great strength, and of great weight. Everything grows in weight,

RICHMOND TRIALS RESULTS (50 MILES), 1899.

	Cylinders.	Seats Occupied.	Weight, Unladen.	Speed.	Fuel Used.
	Inches.		cwts. qrs. lbs.	m.p.h.	Gals.
1. Barriere Tricycle	One—2·75 × 3 Revs. 1400	One	2 0 0	11·05	0·75
2. Cannstadt - Daimler, 4-5½ h.p. Wagonette	Two—3·43 × 4·56 Revs. 720	Four	18 0 0	11·25	2·5
3. Daimler Co. 5½ h.p. Siam Phaeton	Two—3·56 × 4·75 Revs. 720	Four	17 0 0	12·25	1·5
4. ,, ,, 5½ h.p. Rougemont Wagonette	Two—3·56 × 4·75 Revs. 720	Six	19 0 0	11·6	2·25
5. ,, ,, Critchley 4 b.h.p. Voiturette	Two—3·0 × 4·75 Revs. 750	Two	6 3 0	11·15	1·50
6. Benz Dog-cart	Two—4·75 × 5·0 Revs. 500	Four	14 0 0	12·35	2·25
7. Benz "Ideal"	One—4·5 × 5·0 Revs. 400	Two	6 2 0	12·20	1·25
8. International Motor Car Co., Phaeton	One—5·0 × 5·25 Revs. 800	Two	8 1 0	8·70	3·0
9. Lanchester Phaeton	Two—5·0 × 4·5 Revs. 450-1000	Two	12 0 0	12·10	1·75
10. Marshall Phaeton	One—5·0 × 5·5 Revs. 600	Two	—	6·80	3·125
11. Delahaye Phaeton	Two—4·33 × 6·29 Revs. 700	Four	17 0 0	above limit	1·50
11. ,, ,, Speed Trial..	,, ,,	,,	,,	26·90	—
12. Motor Manufacturing Co., Phœnix Car	Two—3·54 × 4·72 Revs. 720	Five	—	above limit	2·50
13. Phœnix Panhard Car	Four— Revs. 750	Two	—	12·10	2·25
14. Vallée Car	Two—3·25 × 5·25 Revs. 610	Two	10 0 0	11·70	3·25
15. Mors Car	Four—2·75 × 4·25 Revs. 1200	Four	15 0 0	10·50	1·25
16. Electrical Undertakings Car (32 miles)	Two—Four - Pole Motors	Two	13 1 9	9·90	—
17. Ducroiset, "Hercules" Car	Two—4·5 × 8·0 Revs. 650	Six	22 0 0	12·90	4·25
18. Bergman's "Orient Express"	One—5·0 × 6·25 Revs. 800	Two	12 0 0	9·55	3·5
19. Construction Lisgeoise "Tourist Car"	One—3·75 × 5·0 Revs. 900	Two	4 0 0	11·7	1·625
			tons cwts. qrs		
20. Thornycroft 3-Ton Steam Lorry (20 miles)	Two—4 and 7 × 5 Revs. 440	—	3 0 0	5·45	coal, 1 cwt. 85 lbs.
21. Straker-Bayley 4-Ton Steam Lorry (20 miles)	Two—4 & 6.5 × 5·5 Revs. 500	—	3 0 0	5·27	coke, 1 cwt 11 lbs.
22. Cannstadt - Daimler (11·8 h.p.) 5-Ton Petrol Lorry (20 miles)..	Two—4·93 × 6·125 Revs. 540	—	3 0 0	3·87	4·0
23. Daimler Co. (7·8 h.p.) 1¾-Ton Petrol Lorry (20 miles)	Two—3·81 × 5·375 Revs. 660	—	2 1 0	5·88	2·75
24. ,, ,, Post-office Van	Four—3·56 × 4·75	—	2 3 2	5·0	3·00

The weights given for Nos. 20, 21, and 22 are only approximate.

and the vehicle becomes unsatisfactory commercially, except for occasional work of the traction engine order and at slow speeds. With moderate loads the cost of repairs to the vehicles and to the roads is minimised, and the very heavy volume traffic, persistent over definite lines, must be left to the railway or tramway.

As to the surface of the wheels, it has been a requirement that the wheels of a light locomotive should be smooth. The trials made by the War Office last year showed that the wheels may be made with ribs close together, with advantage in the construction of the wheels and without comparative disadvantage to well-made roads. The requirement of the Act that the tyres of motor vehicle wheels should be smooth is another instance of the mistaken policy of dictating technical details in new Acts, details which should be left to technical departments and to regulations which can be altered from time to time according to experience.

With regard to the omnibus and the forms we have seen of the earlier days down to 1899, some reference may be made to the public service vehicles which have been run in the past year in different parts of the country. The vehicle that can be bought to-day may be made a successful vehicle if those who are interested in its use, that is to say, the purchasers—the omnibus companies—will remember that the motor omnibus on the common road works under conditions which are much more trying and more arduous, even when it is running on solid rubber tyres, than the railway locomotive running many times the speed. Locomotives on railways—on nice smooth tracks—are never expected to run on day after day without proper overlooking and adjustment, without proper reports as to their condition. The work upon them is done by those who are responsible—the driver, the stoker, and the locomotive superintendent — for their condition and for keeping them in the best possible working condition at the least cost consistent with the greatest running duty. Considering the greater severity of the work of a motor omnibus on common roads, it is obvious that omnibus owners must have rather more stand-by vehicles than are necessary with locomotives, and must see that they have a good thoroughly interested staff in the car-sheds. They should have not merely sheds but comfortable workshops into which those vehicles may be taken, and all the necessary overlooking and adjustments and small repairs conscientiously carried out. Under such conditions they may see the day when these vehicles will be a commercial success.

The motor omnibus is a vehicle called upon to do more than any kind of vehicle has done yet, and it can only do it when it is admitted by those concerned that it is a something which will earn money if money is put into it in the first instance. The common experience at present is that the motor vehicle, when once it is started, is used as though it were like a bicycle, which may be run all day, oiled a little and left in the shed, to start out again to-morrow. If it breaks down, or something goes wrong, it is the fault of the omnibus—not the fault of a very bad system of usage. That is the thing to be altered; and I believe that at the present moment vehicles could be obtained which could be run satisfactorily provided the proper conditions were observed.

Miscellaneous.

THE ECONOMIC DEVELOPMENT OF WEST AFRICA.*

Although West African affairs are engaging more and more attention, the public as a whole continues to display a curious indifference to that part of the world. Yet there are urgent reasons why a manufacturing nation like ours should show keener interest in one of the greatest raw material-producing countries in the world, of which we possess some 700,000 square miles, inhabited by 30,000,000 people. The author of the paper protests against the indifference of the public; the extent of British commercial interests in West Africa are ignored by most, and the future potentialities of the country are insufficiently appreciated. The chief factor which determined the Powers to assume the liabilities they have in tropical Africa was due to the belief that raw material is necessary to an industrial and manufacturing nation, and that each nation must find new markets for the consumption of home manufactures, markets which will pay for such manufactures in raw material. It follows, therefore, that the economic development of tropical Africa is the principal aim which each Power has in view. How can that economic development be best pursued in a manner profitable to the people of Europe and to the people of Africa? If it is to be permanently successful it must be profitable to both.

The paper goes on to point out that two political conceptions—utterly divergent and antagonistic, yet

* Paper read by Mr. E. D. Morel before the Geographical Section of the British Association at Southport.

both alike concerned with the economical development of tropical Africa, and therefore both alike arising from the cardinal factor which led to the partition of tropical Africa among the Powers—are before the world. The adoption of one or the other conception will decide the future of European effort in the black man's country. The two conceptions are defined as Coercion and Commerce: the former is characterised as a revival in aggravated form of the old culture system of the Dutch East Indies, which had to be abandoned owing to the ruin and exhaustion it brought with it. This system is at present in operation in a large portion of tropical Africa. It is based upon the repudiation, or rather the ignoring, of native rights of land tenure; upon the definition of all land not actually built over or cultivated for food-stuffs as "vacant;" and upon the appropriation of all such land and the produce yielded by it. It tends towards the enslavement of whole peoples and brings inevitable ruin in its train. Arguments are adduced to show that, apart from its moral side, this conception is antagonistic to the development of all legitimate European aims in tropical Africa, and that if it is morally pernicious it is also practically short-sighted and injurious, and should be resisted to the uttermost.

The other conception has, the author contends, notwithstanding many material obstacles, produced results which are obvious and visible to all. It is based upon the recognition that the inherent rights of a native of tropical Africa to his land and the produce thereof are the necessary accompaniments of all successful and permanent development work in the interests both of the European and the Negro. The commercial instincts of the Negro are notorious, his adaptability remarkable; the theory that he will not work is untenable in face of the positive results of his labours in the millions of pounds' worth of produce shipped home annually to Europe from West Africa. He merely requires instruction and guidance to prevent wastage and destruction of economic products due to want of knowledge in the preparation and collection of the raw material. An urgent necessity is the careful study of native land tenure as an important factor in economic development, the theory of "vacant" lands being often misleading and open to grave abuses.

The paper then discusses the best means of improving native industries and helping the native to construct new ones, laying particular stress upon the great importance of extending the growth of cotton in, and promoting its export from, the tropical African provinces of the Empire. Reference having been made to various measures which might with advantage be taken by Government to secure these ends, the opinion is expressed that the only right and practical ideal which should govern European action in tropical Africa (which is, and must always remain, a black man's country, where the European cannot colonise and can only supervise) is to teach the native to take pride in his property; to assist him in developing the raw products his fertile soil yields for his own advantage and ours; to make it clear to him that we look upon him, not as a fool, still less as a brute, but as a partner in a great undertaking which, if properly conducted, will confer lasting benefit upon his race and the white over-lords who have established themselves in his midst.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty, in July and August last:—

New Charts.—No. 1859—England, west coast; King-road. 3337—England, east coast; River Thames:—London-bridge to Woolwich; 1471—Ireland, east coast; Kingstown harbour. 3345—France, north-west coast; Chenal du Four. 3342—Greece, Port Kaio, Githion. 3317—Newfoundland, east coast:—Thimble Tickles to Bagg head, including New bay. 3373—West Indies; Puerto Rico island: Mayaguez bay. 478—West Indies, Puerto Rico:—Port San Juan. 3376—Plans on the north coast of South America; approaches to Guanta harbour; Guanta harbour. 3318—South America, west coast; St. Elena point to Gulf of Dulce. 3327—Mexico, south-west coast; Cape San Lucas to Espirito Santo and Sta. Margarita Is.; 3193—Philippine islands; Port Sebu and approaches; Sebu anchorage, Tinaan anchorage. 3329—China, east coast; Mirs bay:—Tolo harbour and adjacent anchorages. 3334—Japan, Nipon island, east coast; Tokyo to Sendai bay. 2655—Nipon, south coast; approaches to Shimoda harbour. 1945—Nipon, Kii channel; Tanabe Wan. 3375—Plans on the south coast of Japan; Hososhima Ko; Shimizu Ko. 288—Russian Tartary:—Ussuri bay; Plan:—Andreeva bay. 3332—New Zealand, North island, east coast:—Mercury bay to Town point. 479—West Indies; anchorages in Puerto Rico island; plan added:—Port Arecibo. 632—Walfisch bay to Orange river; new plan:—Possession-road. 2597—China sea; Banka strait; plan added:—Muntok-road. 1622—Ports in the Philippine islands; plan added:—Parasan harbour and approaches. 3216—Japan; plans on the east coast of Nipon island; plans added:—Oginohama ko; Hirota wan. 357—Japan; harbours in Kii channel; new plan:—Osaki bay.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—

Nos. 3038—Norway; Biörnsund to Kristiansund. 2274—White sea, sheet VI., Kamennoi point and Unskaya inlet, &c. 2276—White sea, sheet VIII., Buin point to Sharapov head. 2970—Novaya Zemlya; Sukhoi Nos to north Gusini Nos. 3035—Plans in Novaya Zemlya. 1461—Italy; Genoa. 280—Newfoundland; Notre Dame bay. 314—North America, River St. Lawrence; Orignaux point to

Goose island. 519—North American lakes; Lake Huron. 853—United States, east coast; St. Andrew sound to St. John's river. 1911—United States, west coast; approach to Juan de Fuca strait. 634—British Columbia; Port Harvey. 40—India, west coast; Karáchi harbour. 1149—Eastern archipelago; Banka strait. 942*b*—Eastern archipelago; eastern portion. 999—Siam; Bangkok river. 1459—China, east coast; Hongkong harbour. 1602—China; approaches to the Yang-tse-kiang. 861—Russian Tartary; river Amur, sheet 1. 862—Russian Tartary; river Amur, sheet 2. 2119—Australia, east coast; Newcastle harbour. 754—Pacific (western); New Hanover, New Ireland, and New Britain. 1423—New Zealand; Port Nicholson.

These charts are issued by Mr. J. D. Potter, 145, Minories.

Notes on Books.

FIRST INTERNATIONAL FIRE PREVENTION CONGRESS, convened by the Executive of the British Fire Prvention Committee, held in London, July 6th to 9th, 1903. The Official Congress Report, with an introduction by Edwin O. Sachs. London, 1903. Folio.

The Congress was attended by a large number of official delegates, both home and foreign, and Mr. Sachs writes that "never before in any country have architects, engineers, surveyors, municipal officials, legislators, insurance officials, and fire surveyors met in council, with professional and volunteer fire brigade chiefs and salvage officers."

The resolutions which were passed by the Congress referred to the terms "fireproof" and "fire-resisting," standards of resistance, the metric system, "testing stations," fire-resisting materials and building legislation, technical education, fire brigades and fire prevention, the legal status of fire brigades, records, publication of technical fire reports, maintenance of private fire appliances, fire insurance rating, insurance influence on fire prevention, theatre safety, theatre fire service, lighting, spontaneous combustion, popularising of fire prevention, consolidation and uniformity in legislation, international publications, and on the publication of the Congress resolutions.

Mr. Sachs is of opinion that "perhaps the most important resolution from a fireman's point of view, was that calling for the due legalisation of their position and their inspection by Government officials. A demand for systematic investigation of every fire by an official appointed for the purpose, who should make a report on the cause of the outbreak and all the circumstances connected therewith, was strongly supported."

The general report is entirely in English, although three languages were in constant use during the proceedings. The papers presented in French and German are printed in the original in a special Appendix. The Congress resolutions are also printed in the French and German languages as well as in English. The report is published for the British Fire Prevention Committee by the Public Health Engineer.

Mr. Sachs expresses in his introduction the opinion that the most valuable achievement of the Congress might be summarised under three heads:—"(1) It has laid the basis for the foundation of an effective international policy for the prevention of fire, based upon a regular international exchange of experience and thought; (2) It has brought about an international understanding on the subject of requirements of and methods of testing 'fire-resistance' in building materials and system; (3) it has assisted in breaking down the barrier between some of the personal and vested interests of fire prevention and fire extinction, and has brought together leading representatives of each of these branches with the happiest results."

General Notes.

SCHOOL OF ART WOOD-CARVING.—The School of Art Wood-carving, South Kensington, which now occupies rooms on the top floor of the new building of the Royal School of Art Needlework, in Exhibition-road, has been re-opened after the usual summer vacation, and some of the free studentships maintained by means of funds granted to the school by the Technical Education Board of the London County Council are vacant. The day classes of the School are held from 10 to 1 and 2 to 5 on five days of the week, and from 10 to 1 on Saturdays. The evening class meets on three evenings a week, and on Saturday afternoons. Forms of application for the free studentships, and any further particulars relating to the school may be obtained from the manager.

AUSTRIAN BEER PRODUCTION.—From 1855 to 1873 the production of beer in Austria had risen from 133,000,000 gallons to 337,000,000. In the latter year a reaction took place, in consequence of which the production up to 1880 fell to 27,000,000 gallons. Since 1880 the growth of the brewing industry, which turned out 556,000,000 gallons in 1902, was not further interrupted until the last brewing season, which shows the remarkable decrease of 12,000,000 gallons. The revenue derived from the beer tax in Austria amounted in 1901-2 to £3,050,000, against £3,089,000 in 1900-1901. The new provincial beer tax of nearly $\frac{3}{4}$d. per gallon came into operation in 1903. The proceeds from this tax in Bohemia will not go into the Government treasury, but will be applied to the long-promised increase of the salaries of public teachers. In 1902 the hop crop of Austria-Hungary amounted to 19,800,000 pounds, while that for 1901 amounted to 33,000,000 pounds, a decrease in the crop of 1902 of 14,600,000 pounds. Of the total crop of 1902, Bohemia produced 14,000,000 pounds, of which 9,000,000 pounds were produced in the Saaz district.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CANTOR LECTURES.

MECHANICAL ROAD VEHICLES.

By W. Worby Beaumont, Mem.Inst.C.E.

Lecture III.—Delivered May 11th, 1903.

In the preceding lectures an attempt has been made to give a sufficient account of motor vehicles and motor vehicle questions, so as to connect the state of the art as depicted in the Cantor Lectures of 1895, and in the 1896 paeer by the author, with that of the immediately succeeding years.

Among other salient features, it will have been observed that the vehicles propelled by internal combustion motors almost monopolised the field of advancement. Secondly, it will have been seen that Levassor's design and arrangement of transmission and change speed gearing have, in spite of the objections to sliding toothed gears nto mesh sideways, continued to command adoption even by many who tried to avoid the objections by other arrangements.

The general principles of the arrangement by Levassor, as illustrated by Fig. 38 of the 1895 Cantor Lectures (*Journal*, vol. xliv. p. 154), were followed in the Coventry Daimler cars, illustrated by Figs. 1, 2, and 3 (see *ante*, pp. 904-905), which were copies in all main essentials of the Panhard and Levassor design. The vertical engine in front of the car and over or immediately behind the leading wheels became the favourite, very much because of the success in races of the Panhard and Levassor and the Mors cars. Many successful belt-driven cars continued to be made until quite recently with horizontal engines, generally at the back of the car, but a few in front, including the Benz or Benz-Parsifal 1902 cars. Makers of other well made cars, more particularly in England, adhered to the horizontal engines, including the Wolseleys, from 5 to 50 horse-power, and the James and Brown car, designed by Mr. F. L. Martineau.

Some examples of the changes between 1901 and 1902 may be referred to.

Fig. 11 is an exterior view of one of the large touring cars now made by the Daimler Company at Coventry. It is a very fine car, of 22 brake horse-power, with a four cylinder engine, running nominally at 720 revolutions per minute, governed by a governor and at will by hand throttle valve. The change gear is in principle that of the car shown by Figs. 2 and 3, but the gear box is at the rear of the car, driven by a jointed propeller shaft, the clutch being modified so that no end thrust occurs on the crank or other bearings. The four speeds are controlled by one lever, and the reverse by a separate lever at the driver's right hand. The final drive is by chain. The cooler is of a new, neat pattern, and has about 110 feet of ½-inch tubes between the tube plate and ribbed chambers seen at either side. The car weighs about 25 cwt. without the canopy, and is similar to one supplied to the King. Compared to Figs. 1 and 2 it will be seen that the 1899 and the 1902-3 cars, even allowing for the great difference in power, have a strikingly different appearance, largely due to the low centre of gravity of the whole, and the use of wheels all of one diameter. The wheel base is 8 feet, and, as shown, is fitted with Goodyear heavy detachable pneumatic tyres.

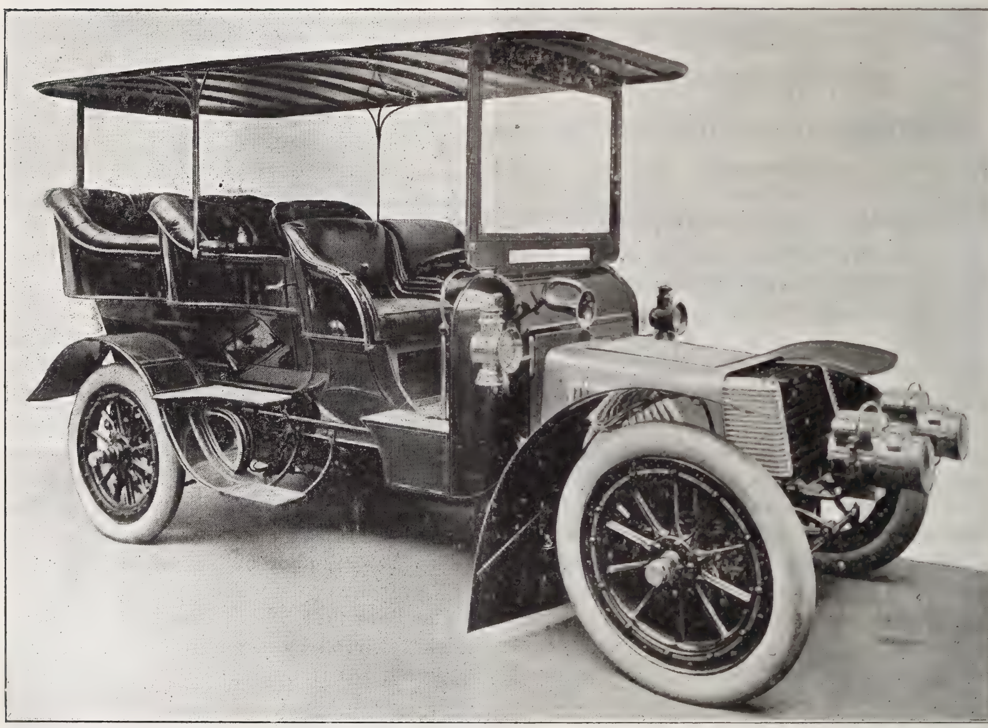
The Benz firm, whose cars have long been much favoured by those who like easy and moderate pace running, found it necessary to comply with the demand for cars with the engine in front under a bonnet, and for this purpose they modified the arrangement of belt drive from engine to sprocket countershaft; and used instead an intermediate belt driven spindle in a gear box with change speed wheels driving the sprocket pinion shaft. A large number of cars of this design were made and are still in use, many for letting out for semi-public purposes. New purchasers, however, lean towards the cars of the more fashionable makes either of Continental or British manufacture, and hence the Benz firm is now ceasing to manufacture any of the cars with which we have hitherto been familiar, and instead are making the Parsifal car, which is of the Panhard type,

but with gear driven live axle, mechanically operated inlet valves and magneto low tension ignition apparatus of simple, light and effective form. The engine of the 10 horse-power car has two cylinders of 4 inches diam. and $4\frac{3}{8}$ inch stroke, running at from about 300 to about 1,200 revolutions per minute, and using a spray-maker float feed carburetter.

The change of design adopted by the Benz firm affords an epitome of the changes from different designs of say four years ago towards a consolidated pattern on the continent and to some extent here. There are, however, on the continent no counterparts of the strong, well-designed and well-made cars made in England with horizontal cylinders.

The next car (Fig. 12) to which reference may be made is one of the Motor Manufacturing Company's 20 horse-power. This affords an example of the great increase in the length of the wheel base of cars now made, as compared with cars with the same number of seats two years ago, a change which secures much steadier running at the higher speeds. This car has a wheel base of 7 ft. 10 in. It is fitted with a four cylinder motor with automatic inlet valves, and high tension electric ignition apparatus is used. The change speed gear differs from the Levassor arrangement in that the wheels and pinions are always in mesh, and are selectively put in or out of gear by sliding claw clutches on Iden's plan. This gear works well, and excellent performances of some of these cars are recorded. The car shown is fitted with a special touring body and canopy. It is chain driven, and is a good example of English make of car.

FIG. 11.

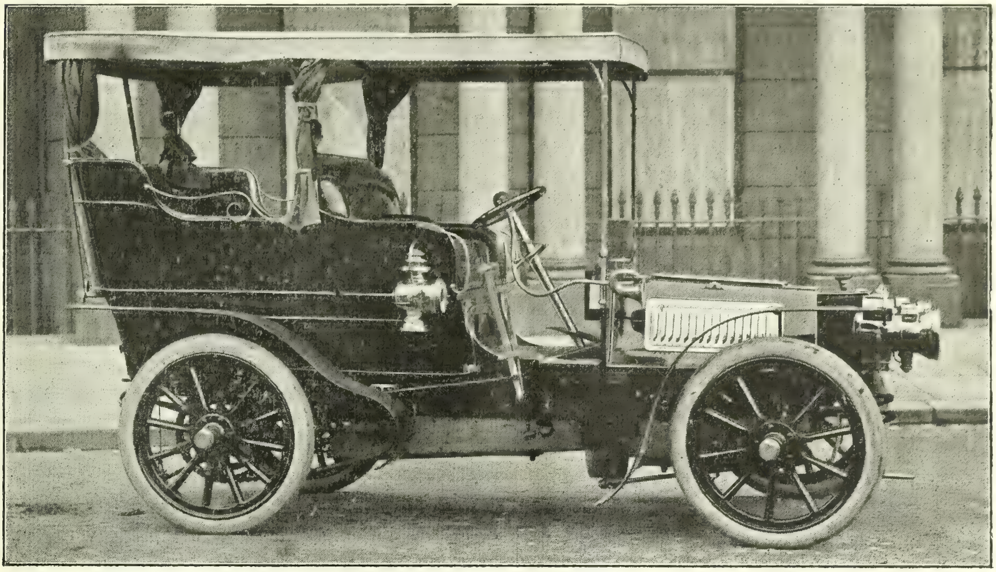


22 H.P. DAIMLER TOURING CAR, WITH SEVEN SEATS.

Another large car is the 16 horse-power Brush Company's car, a branch of manufacture which that company has taken up no doubt with the object of being ready for the railway and tramway feeder work which will be done ere long by the motor vehicle on common roads. This car is built on Panhard lines, and is well made.

The car shown in Fig. 13 is another example of small English built cars, namely, the Swift car. The car contains several departures from common practice, and is a light car, of moderate price. That illustrated is 6 horse-

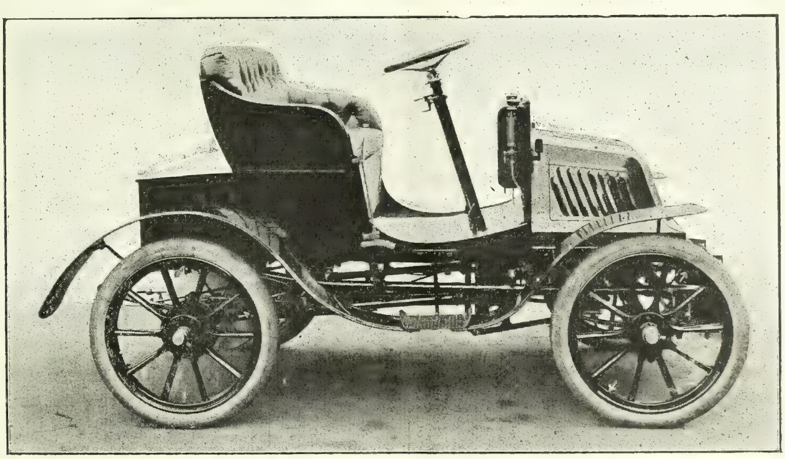
FIG. 12.



20 H.P. MOTOR MANUFACTURING COMPANY'S TOURING CAR.

power, and is driven direct from the engine crank shaft by a clutch and tail shaft connected to the spindle, carrying bevil pinions driving the bevil wheel on the axle, as shown by Fig. 14. The two bevil pinions on the right, gear, as will be seen, with two bevil gear rings on the main wheel. They are loose upon their spindle, and can be alternatively fixed by a claw clutch between them, operated from the seat in the usual way. The pinion which is not in gear runs idle upon its spindle. The pinion for the smaller wheel might be formed with the claw clutch for fixing the pinion of the larger bevil wheel it would then be out of gear when the slower speed pinion is driving. No doubt the objeciton to this, is the use of parts which would be necessary to keep a sliding bevil pinion firmly in pitch position. The arrangement adopted is very simple, and the same may be

FIG. 13

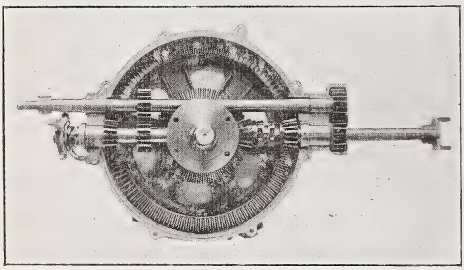


THE SWIFT COMPANY'S 6 H.P. LIGHT CAR.

said for the reversing, which is done by throwing the two forward bevil pinions out of gear, and putting the rear pinion into gear by the small claw clutch on the end of its spindle, and thereby causing the small parallel shaft and its spur pinions to operate. The driving axle on which the bevil wheel is fixed is a solid through axle, no differential gear being employed, but instead of it the road wheels are driven by a form of ratchet or free wheel gear, which can be put out of gear when it is necessary to run backward. Some objection is raised against this arrangement because the wheel on the inner side of a curve is above the driver, but it is questionable whether this is of any practical importance in so small a car except on curves of very small radii.

Several forms of motors or engines have been brought out from time to time with the object

FIG 14.



TRANSMISSION GEAR OF 6 H.P. SWIFT CAR.

of balancing the reciprocating parts. One of these which has been largely used is that of the Gobron Brillié car, in which as in some gas engines such as the Linford of some years ago, two pistons reciprocate in opposite directions in each cylinder, the compression and combustion spaces being in the centre between the two pistons and the upper pistons connected together with a crosshead whose motion is communicated by side connecting rods to the crank. The balance set up by receptive parts and partly that due to the angular movement of the connecting rods is thus avoided. The vibration, however, due to these is only part of that which it is sought to remove, the great part in many engines and cars being due to the occasional impulse which has to be imparted to the fly-wheel, and is resisted in part by the inertia of the engine and in part by that of the parts of the car to which it is attached.

Another method of obtaining a balanced engine is that adopted for the Lanchester Company's car, in which two opposite cylinders are connected to two gear connected crank shafts by two rods from each cylinder. With this arrangement, which is similar to a duplication of the engine with two connecting rods used in some of the Thwaite and Carbutt blowers, and with a fly-wheel on each of the shafts, a balanced engine is obtained. Even with this, however, the effect of varying torque is not eliminated when the engine is driving the car, but of course this variation is small and not observed. The Lanchester differs in other respects from the more general designs of cars. One of the fly-wheels carries heavy bar magnets forming the magnet parts of a magneto machine for effecting ignition. The cylinders are air cooled, two fans being used. Power is transmitted by worm and wheel gear on the main axle controlled by epicyclic gear for two speeds, held or released by friction grip blocks or bands, similar gear being used for reversing, and as one of the brakes. When the engine is running this brake may be applied to the full power of the gear to reverse the motion of the car. The main brake consists of a form of cone clutch put into or out of contact as brake power is required. The cone clutch brake holds the jointed propeller shaft which conveys motion to the worm spindle. The rotation of the worm is thus checked or prevented, and the brake consists in holding the driving axle by means of the worm wheel. The car frame and axle mounting are features of the car, which, with the worm and wheel propulsion, give very smooth riding. There are, however, differences of opinion as to mechanical efficiency of worm gearing. The carburetter employed in the Lanchester car is of the wick surface evaporation type and of novel construction. It is stated to work quite successfully, although the more primitive type used with the Vivinus cars when first introduced into this country was given up in favour of a float feed carburetter. It was said to give trouble in very damp or wet weather in England, although alleged not to be so affected in Belgium. It is not, however, used in Belgium now.

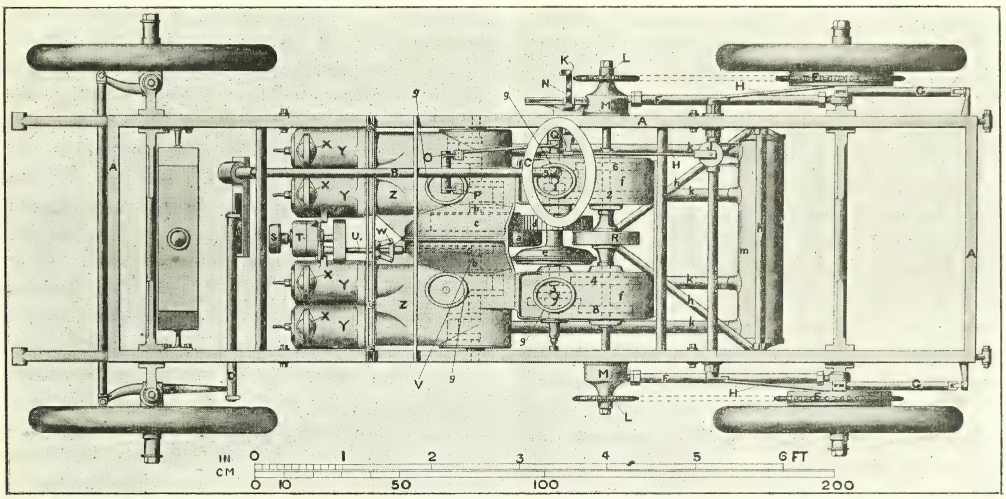
Another English car is in part illustrated by Fig. 15, namely, the James and Brown car, with an 18 horse-power four-cylinder horizontal engine, which is enclosed with all the speed change gear. The car is also made with a 9 horse-power double-cylinder motor with the same arrangement of gearing. The 9 horse-power engine has a straight crank shaft with balanced crank-pin discs at the ends, and a

strong central drive spur wheel between the two bearings. This transmits motion to a corresponding spur wheel, *d*, fastened to a sleeve extension of the cone clutch, *e*. The clutch is one of those now made in which the male portion is pushed inwards for declutching instead of being pulled out, as is the case with the cone clutch as formerly used in the Panhard, the Daimler, and most other cars. This produces a balanced clutch in which the pressure of the springs which force the parts into contact imposes no thrust on bearings or spindle ends. The arrangement of the clutch operating parts and of the clutch spindle is in both cases novel and particularly good and are applied to the main wheels.

The Dietrich car now being introduced into England is a good example of the changes which the period under consideration has introduced. Two years ago the Dietrich car had for propelling gear a curious complication of bevil gear with longitudinal and cross spindles all round the back of the frame. Now it is a fine example of the most recent development on Panhard-Dietrich-Mercedes lines.

Another example of one direction of recent practice is the Ariel 16 horse-power car. The small very high speed De Dion engines have

FIG. 15.



18 H.P. JAMES AND BROWNE CAR—PLAN OF UNDERFRAME AND MACHINERY.

productive of easy and satisfactory working. The 9 horse-power engine has cylinders 4 in. diameter and 6 in. stroke, and it runs normally at about 750 revolutions per minute. The valves are arranged in the dome-shaped ends of the cylinders vertically one above the other, so that there are no pocket-like passages or ports, and the ignition plugs are inserted in the centre of the compression space. The plugs, therefore, remain clean, the exhaust gases are well cleared out, and ignition is certain.

A centrifugal form of pump is used for circulating the jacket water, and the cooler is built up of pipes larger than usual in diameter with radiating gills, so put on as to hold the tubes in their proper relative position, and the whole is electro-tinned by Martineau's method. The brakes on this car are also done so well, and worn so well in tricycles and quadricycles, that it has seemed to some makers quite reasonable to suppose thev might do equally well when coupled together to make a four-cylinder engine for propelling a car of considerable size. The Ariel Company has done this, and in the car mentioned the 16 horse-power engine is made up of four cylinders, 3 and 5-16ths inch diameter and 4 inch stroke, running at a normal speed of 1,400 revolutions per minute, and capable of running at over 2,000 revolutions per minute, or over 4,000 strokes per minute, or 70 per second. We may remember that it is only a few years since Daimler astonished us by running his little engines at 700 revolutions per minute, and that we thought it a dangerous practice, but we find it difficult now to believe the proof

before our eyes of the fact that 2,500 revolutions per minute can be successfully run by small petrol engines, so far at least as the engines themselves are concerned.

Another illustration of the conquest of the internal combustion motor for mechanical road vehicles is afforded by the view now before you of the Thornycroft 10 horse-power petrol motor Tonneau body car. The Thornycrofts are admittedly masters in high-speed steam engine and boiler practice. Yet when they enter the field of light motor carriage building they turn to the petrol or internal combustion engine which cuts out the steam generator. I am not in possession of details of this car at present, and the photograph you see would do equally well for others of the Panhard general type. The car is, however, carefully designed with a view to simplicity. It has an engine with two cylinders, 4 inch diameter and $4\frac{3}{8}$ inch stroke, and runs at 900 revolutions per minute to 1,400 revolutions.

The next view is from a photograph of the Right Hon. A. J. Balfour's 12 horse-power Napier car, with which the Premier has found that he can run 50 or 60, or 70 miles between breakfast in London and lunch in Bedford or Peterborough, with enjoyment to himself, and without doing the slightest harm to anyone, while he at the same time earns the necessity for a forced contribution to the local rates in some places on the road, some place where the bucolic magistrate has descended from those who prosecuted Meikle because his winnowing machine cleaned corn by an artificial wind, which was of course an improper thing because it had not been used before their time.

In 1895 and 1896 the Serpollet car was the only light steam car of which any particulars could be given. In the past two years M. Serpollet has again turned his attention to these and has made immense modifications in the cars as now made as the Gardner-Serpollet cars. The engines have been modified, slide valves have given place to gas-engine valves, and the boilers have ceased to be capillary tube or semi-capillary, but are made of simple ordinary small thick circular tubes of grid upon grid heated by paraffin or kerosene burners of the Swedish pattern grouped together in numbers to suit the size of the boiler. M. Leon Serpollet is a patient and prolific inventor and a daring driver of his cars, with which he has reached about 60 miles per hour on common roads. He has, however, found a competitor for moderate speeds in the Locomobile car which is a product of New England. The Locomobile car is a simple car with a simple little toy of an engine with link motion valve gear. On its crank-shaft is a sprocket pinion on which runs a chain which drives a wheel on the differential gears on the live driving axle. The boiler is the astonishing and paradoxical novelty, or was three years ago. Those who knew most about all kinds of land, and locomotive, and marine boilers knew that these boilers were of no use whatever. They found out, however, that those who knew everything about boilers had a good deal to learn when they began to deal with motor cars. The locomotive boiler (the Stanley and the Whitney) are little things about the size of a large bandbox, but filled between top and bottom with over 300 brass or copper tubes, 7/16 inch diameter inside and 13 inches in length, giving a total of about 30 square feet of heating surface, and generating steam enough for a little engine capable of 3 horse-power in the ordinary running, but of 5 horse-power for a short time when the pressure is temporarily run up from the normal of about 150 lbs. to 250 lbs. These boilers ought to become rapidly unworkable through incrustation, but they do not when the most elementary care is taken of them. They are, however, steam boilers, and have various steam boiler appliances and connections which an internal combustion engine does not require.

The White steam car has a water-tube boiler, and is made by the White Sewing Machine Company, in America. This car has been recently completely re-modelled, and has now the appearance of a petrol car, with its engine under the bonnet in the front. It runs well, it condenses its steam, runs considerable distances on one supply of water, and pleases many people by quiet running. Its steam generator supplies the engine with superheated steam, and it is, therefore, very economical, although, as it uses petrol for its fuel, it burns a good deal more than an internal combustion motor car for the same load and distance and speed.

The boiler is made up from small steel pipes into a series of horizontal coils with vertical parts of the tube, making what is virtually one long coil. The water from the feed pump enters one end of the coil, near the top of the tubular structure, and the steam end of the coil rises from the lowest, or one of the lowest parts of the coil, and delivers its steam at the top part of the boiler casing.* Other light

* *The Autocar*, 13th September, 1902, p. 283. *The Automotor Journal*, July 4th and 18th, 1903.

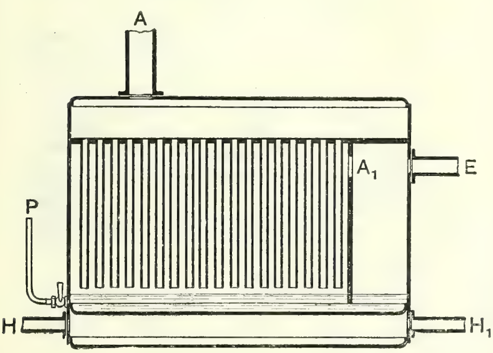
steam cars, including the Toledo, are of the Locomobile, or Whitney and Stanley type, fitted with similar fire-tube boilers.

A detail of the internal combustion petrol motor upon which a great deal of ingenuity has been spent is the carburetter.

Until comparatively recently the surface evaporation forms of carburetters were very widely used, and they are still in use for motor cycles, and as already mentioned one such form is used in the Lanchester car.

The facility with which air could be carburetted by contact with surfaces wetted with petroleum spirit, or with benzoline, had been turned to practical account for a good many years in the construction of the Alpha and other small plant for making a lighting gas for houses where a gas supply could not very well

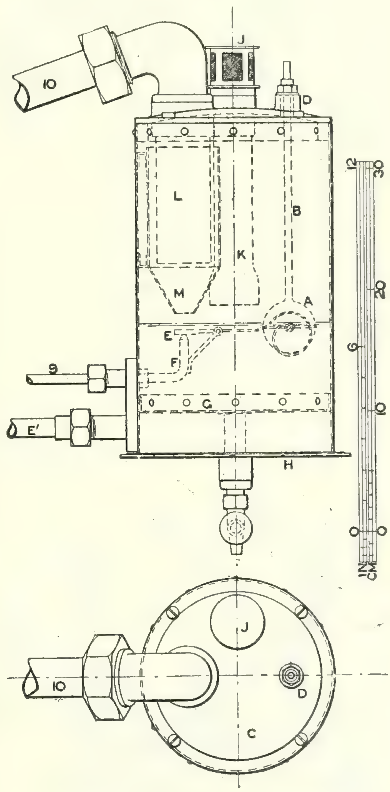
FIG. 16.



BLACKBURN'S CARBURETTER.

be obtained. Several forms of compact carburetters formed the subject of patents in this country before the date of the recent requirements for motor vehicles. One of these was that used by Blackburn for making a combustible gas for heating the coiled tube boiler of his light steam dogcart. This is shown in Fig. 16. It consists of a rectangular vessel with a tube plate in the upper part, from which depend a number of tubes touching or nearly touching the spirit in the lower part of the vessel. Air enters at A, passes down through the tubes, impinges on the spirit or bubbles through it, and is drawn away at E, carburetted by the evaporation of the spirit. At the bottom of the vessel is a compartment through which warmed air passes to raise the temperature of the spirit, for encouraging evaporation in colder weather. The surface evaporator used in the De Dion and similar other tricycles consisted mainly of a very elementary form of this carburetter, but the surface carburetter used in the Benz cars was on similar lines to that of Daimler's early carburetter, and is illustrated by Fig. 17. In it air enters the gauze-covered pipe at J, passes down through K, where it impinges upon the surface of the petrol, where it takes up more of the hydrocarbon than is really necessary for the combustion of the motor. The rich vapour so formed is sucked up the pipe, L, surrounded by the cylinder, M, and passes away at 10, the

FIG. 17.



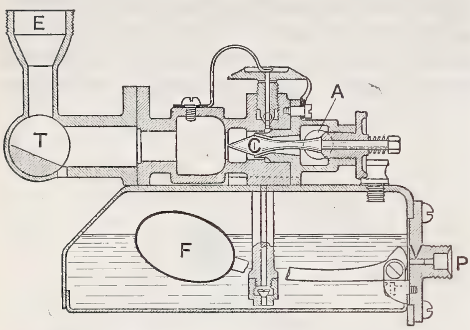
THE BENZ CARBURETTER.

cylinder round L being covered by gauze, and any suspended globules of petrol are caught by it, and dripped down to the conical extension of the cylinder at M. The level of the petrol, which enters at 9, through a nozzle, F, is maintained by a float-operated valve at E, a rod, B, from the float passing out at D, and acting as a petrol level indicator. A small shunt pipe from the exhaust permits the entrance into the space at the bottom of the vessel, of warm products of combustion for heating the petrol. These must suffice as

illustrations of the earlier forms of surface carburetters.

An early form of spray making carburetter is that used by Edward Butler, in 1885-87, as shown by Fig. 18. In this, the spray

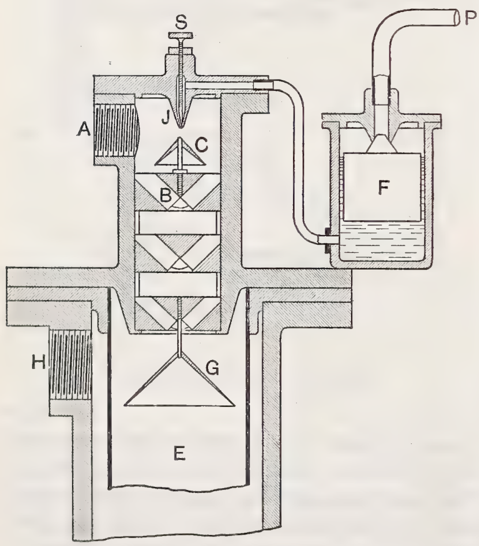
FIG. 18.



BUTLER'S CARBURETTER.

maker is mounted on the top of a small float feed vessel, with a float, F, and air drawn by the engine piston through the carburetter, past the cock, T, enters at A. and in smaller quantity through the central hole in the regulating valve, W. Petrol flows by the pipe

FIG. 19.

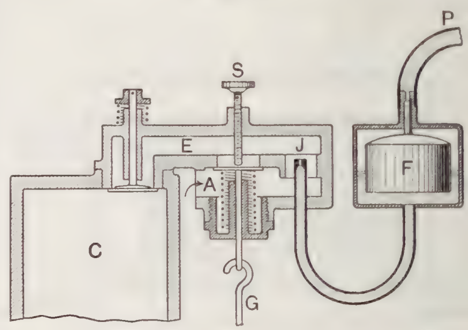


WILKINSON'S CARBURETTER.

from the containing vessel, and enters just above the cone-ended regulator screw valve, W; it is drawn in by the injector action of the air passing through the cone, C, and the small quantity of air entering through the stem at W. This carburetter became automatically variable as to quantity and quality of mixture with the speed of the engine, as the more powerful the suction by the engine at higher speeds, the larger became the annular opening round C, owing to the sliding of the part C toward T, governed by the spring at its end. Another form of float feed carburetter is that of Wilkinson, shown by Fig. 19, in which the float F controlled the level of the liquid, the quantity of which passing at any moment was adjusted by the needle valve S. Air entered at A, the petrol impinged on C, and was taken up by evaporation in the baffle passages B, and passed the second cone G, down the pipe E, and then upwards to the engine suction connection at H.

After this came the Daimler-Maybach carburetter, one of which is shown by Fig. 20. In this C represents the engine

FIG. 20.



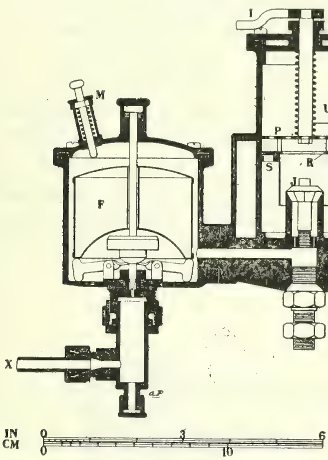
MAYBACH'S CARBURETTER.

cylinder which by suction drew air in through the passage A, and the annular hole round the petrol jet J, through the passage E, and past the inlet valve into the cylinder, a small spray of petrol being taken from J, and converted into a mist or vapour. In the form shown an additional air inlet was provided by a valve supported by a spring at A, and regulated by a governor or otherwise acting at G. This valve could be set by the screw S, so that it did not quite close, and could be controlled by the governor so that the quantity of air passing the valve should be greater, the greater the speed of the engine, so that the induction action at J should give the same or similar quality of mixture, at E, at all times.

Turning now to the more recent carburetters of this kind, we have in Fig. 21 a section of the Longuemare carburetter, which has been so much used on Continental vehicles. The float F in its vessel will be readily understood.

Petrol enters at X when the float falls and bears upon the little levers which raise the valve. Instead of one small jet the Longuemare carburetter has a conical valve-shaped piece screwed into the small cylinder at J, the face of this piece has made in it a few very

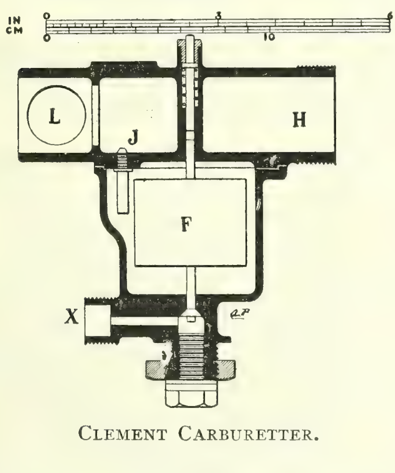
FIG. 21.



LONGUEMARE CARBURETTER.

small grooves instead of the jet used by others. Air passing in at L enters the annular space between the tube and the cylinder supporting J, and so induces the flow of a small quantity of petrol with it through the passage R, and

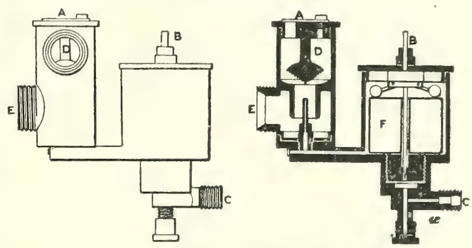
FIG. 22.



CLEMENT CARBURETTER.

thence through the small holes in the plate, which may be partially rotated by the lever I, on the top of its spindle. Connected to the perforated plate is an interrupted plate R, which covers or uncovers parts seen below it. When the quantity of petrol drawn out at J gives too rich a mixture the turning of the plate R, permits air to pass through these parts shown as covered, and the velocity of its passage round J is thereby reduced. Regulation of the quality of the carburetted air is thus effected by the lever I. To control the quantity of the gas going through H to the engine cylinder a semi-rotative throttle valve U, is actuated by a lever I_1.

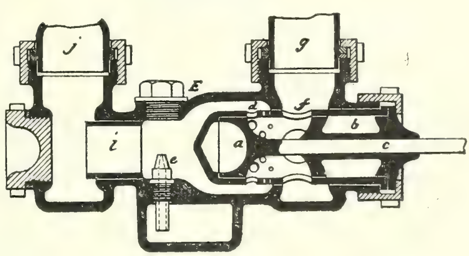
FIG. 23.



KELECOM CARBURETTER.

Several varieties of this form of carburetter have been employed, and a very simple form, as used in the Clement cars, is shown by Fig. 22. Air enters at L, through holes more or less covered by a hit-and-miss cap. It passes the petrol jet J, maintained at a constant level by the float F, connected at H to the engine. The suction by the engine pistons draws in the air, and triturates and vaporises the petrol escaping at J.

FIG. 24.



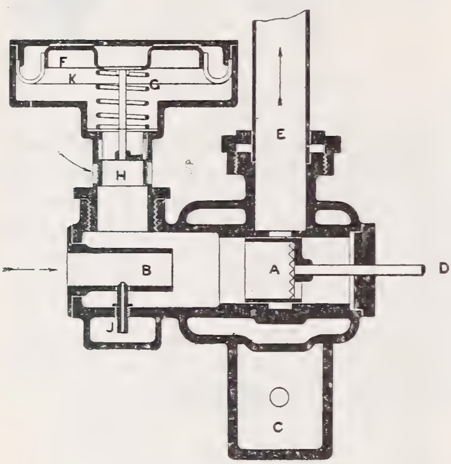
PANHARD AND LEVASSOR CARBURETTER.

One more view of many must suffice for the illustration of carburetters recently used by well-known makers. Fig. 23 is the Kelecom carburetter used in the Ormond motor bicycle, and which the preceding explanations will make readily understood. Fig. 24 is the carburetter used in the Centaur type of Panhard and Levassor cars. In this air enters at *j*, passes through the short tube at *l*, past the jet *e*, through the ports *d*,

and thence through the openings *f*, by way of pipe *g* to the engine, the quantity being controlled by the governor attached to the rod *c*, and operating the piston valve *a*, closing, more or less, firstly the larger holes at *d*, and finally some of the smaller holes near them, but never quite closing them all. With this arrangement not only was the quantity of the carburetted air going to the cylinders varied, but it was reduced to so low a velocity at the higher speeds of the engine that no petrol was drawn through the jet at *e*. With this carburetter, therefore, the engine could not be run at very varying speeds.

As a modification of this, the Krebs carburetter was made as shown in Fig. 25, in which

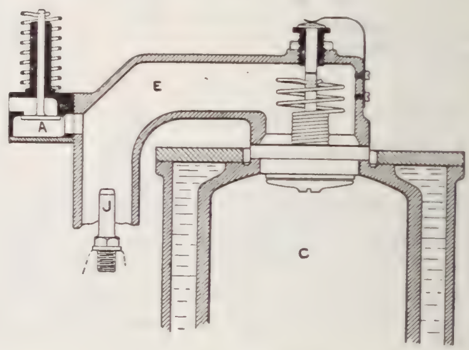
FIG. 25.



KREBS CARBURETTER.

at the lower speeds the piston valve A completely uncovered the parts leading to the pipe E to the engine. Air entered through the tube B, corresponding to *l* in the last-mentioned figure. The jet and the tube B being arranged to suit the mixture required for the slowest running of the engine, the quantity of petrol drawn in would, of course, be too large at the higher speed and stronger suction of the engine. In order, therefore, to obtain a similar strength of mixture throughout a considerable range of speed of the engine, an inlet valve of ported piston form is used at H, to which considerable movement is given for small variations of suction by its action on the piston F and diagram K. The parts controlled by the piston valve H are of approximately delta form, thus, Δ, their precise form being determined by consideration of the variation of the rate of increase of suction pressure with increase of engine speed. It will be seen that this Krebs carburetter consists mainly of the addition of the diaphragm piston F, and ports H, to the opening at J of the last-described figure, and the removal of the plug opposite the short tube, L. It will also be seen that the action is similar to that obtained by the previously mentioned Butlers and Maybach's carburetters, and is in some respects similar to that which would be obtained with the Bradley and Pidgeon arrangement illustrated at the left hand lower corner of Fig. 26, which also shows the last-mentioned inventor's method of applying a double spring to the automatic inlet valve with the object of an adjustment which leaves the valve barely or only lightly sitting on its seat under normal conditions. The

FIG. 26.



BRADLEY-PIDGEON CARBURETTER AND VALVE.

object of this is to have a valve which readily admits of the easy inflow of the gases with but very slight suction or minus pressure in the cylinder.

I must now merely mention other forms of carburetter, including the Gobron-Brillée*, in which an actual measurer of the petrol passed into the air passage in accordance with the speed of the engine as controlled by the governor is used; also the Roots' vapouriser with a measuring valve, equally applicable as a carburetter; the recent form of modified Longuemare used by MM. De Dion and Bouton, the Duryea simple carburetter, the Oldsmobile, in which the quantity of petrol passing is governed by a diaphragm actuated by the suction or speed of the engine, the Germain, which is an extremely simple form embodying the principles adopted in the Kueles and other carburetters as mentioned,

* "Motor Vehicles and Motors," p. 192-3.

the Martha, the Reliance, the Vaux, the Friedman, the recent form of the Daimler, and others.

As a relief from the dryness of these details I may now draw your attention to some photographic views of the following cars, which I may more correctly describe as racing machines intended for the Gordon-Bennet race in Ireland in July, for the Gordon-Bennet trophy. [Here the lecturer briefly described several of the Gordon-Bennett racers, which have been since very fully illustrated in the various weekly illustrated journals in June and July last.]

I may also call your attention to the specimens of motor vehicle tyres, which have been kindly sent here by the Dunlop Company, showing the construction of the outer covers, valves, and rims used for vehicles of different weights; also to the tyres which have been sent by the Collier Tyre Company, those shown being two of the tyres actually used in the 4,000 miles tyre test trials carried out by the Automobile Club last autumn. It will be seen that these tyres are in splendid condition even after that extended and severe test. The results of these tyre trials were very much in favour of the Dunlop tyres, to whom the first prize was awarded, these tyres being much lighter and somewhat more resilient than the heavier, thicker tyres of the Collier Company. The wear-resisting qualities of the latter tyre are, however, very clearly shown by the tyres now exhibited.

Of electrical cars there is very little variety in either the principles of design, or in the practice as to the batteries, motors, or general arrangements of the machinery. Very great strides have, however, been made since the Cantor lectures of 1895 and the paper of 1896, and for those who can afford to pay for an electrical vehicle and its maintenance, a thoroughly practical and trustworthy vehicle with any form of body can be had. After a period of chequered technical struggles and financial spoliation in this country and in America, where the best designs of electrical vehicles originated, the electrical cab and landau were taken under the combined organising capabilities and financial control of Mr. E. Paris Singer and the City and Suburban Electrical Vehicle Company.

In these hands, amateur management, and all attempts to run a 100-vehicle business with 100 vehicles was given up, and a new system adopted, so that every vehicle could be properly kept in order, adjustments and renewals made whenever and as soon as necessary, and a complete system of battery charging, inspection, and testing organised.

The company undertook the manufacture and sale of all kinds of vehicles such as are mostly required for town use. It also established a complete system under which the purchaser, for a fixed sum or sums per year, can have his vehicle stored, cleaned, maintained, accommodation provided for his driver, and his vehicle always at his command.

There are also now the Electromotive Power Company and the British Electromotive Company which is making cabs and other such vehicles on a large scale, the vehicles being made by Messrs. Greenwood and Batley, of Leeds, under the superintendence of Mr. T. G. Chambers.

One of the first to make a satisfactory light electrical vehicle with the now most-used frame, rigid horizontal, but flexible vertically, was Riker, of Brooklyn, New York. In the vehicles by Riker, a single two-pole drum armature series wound motor was used, pivoted on the driving axle, suspended by top and bottom springs in front, and single reduction geared to a single driving wheel on the axle. In many respects this arrangement is followed in some of the best cars now made, but with a different arrangement of wheel hubs and differential gear, the latter in Riker's cars having been in one of the wheel naves, and the torque of driving the near wheel conveyed through an interval axle the whole length of the distance from one road wheel to the other. The motor gave about 2½ horse-power at 1,000 revolutions per minute, and with about 25 amperes at 80 volts, and weighed about 175 lbs. The battery was carried in the body of the four-wheel dog cart, and occupied all the space. It consisted of forty-four cells, having a total capacity of about 130 ampere hours and a discharge rate of about 25 ampere hours, but it would only run the car about 25 miles on level roads at 12 miles per hour. The battery was in four boxes, which automatically made contact on being put into place, but had to be removed to be charged.

Other well-designed vehicles were made by Messrs. Morris and Salom, of Philadelphia, who used the body frame of their cabs to carry the various machinery attachments instead of using a separate under frame and reaches as in Riker's vehicles, and in those made by the Columbia Company of Hartford, Connecticut. Messrs. Morris and Salom made the vehicles for the American Electrical Vehicle Company, and used two motors and no differential gear.

Each motor drove by a pinion on the end of its shaft gearing within an internal ring on each front wheel acting as driver. The motors were each 2 horse-power at 700 revolutions per minute, and the battery had a capacity of 100 ampere hours at 80 volts at normal discharge, over a total run of about 25 miles. Manchester positives and chloride negatives were used, but other forms were also tried. The battery was in two sections, and the series wound fields of the motors were also in sections, so that various combinations in series and in parallel were obtainable for giving three speeds forward and a reverse. All these American vehicles* were well worked out and well made, and many were sent to this country and to France.

The London Electric Cab Company commenced running cabs in London in 1898, and took them off in 1899. These vehicles were very heavy in every respect, their total weight with battery about two tons without passenger or driver. A 3 horse-power Lundell motor was used, driving a sprocket pinion countershaft, which conveyed motion to the rear driving wheels at first by silent chains, then by one block chain and then by two chains. The whole of the arrangements of the company's generating station and the methods of generating current and charging the batteries were costly, and the cabs were costly and still more costly to run. A ton of dead weight per passenger for an electrically-propelled vehicle to run on common roads meant a commercial failure before it began work.

The construction of lighter vehicles, of motors better suited to the requirements, with some improvements not only in the batteries in themselves but more particularly in their usage, have made it possible to-day to produce electrically-propelled vehicles much more economical,† and satisfactory to those who do not object to pay as a luxury for their convenience, cleanliness, and quietness. At no very distant date their radius of travel will no doubt be increased, by the extension in the numbers of vehicles in use, by the standardisation of the cells and batteries and methods of connection, by universal methods of exchange of cells and batteries, and by extended knowledge and care in the use and charging of the cells. This must, however, be of gradual growth, and for a field more limited than that of vehicles less heavily weighted, of longer range, and cheaper propelling power. The storage battery may be slightly decreased in weight, but any great decrease must wait for the discovery of other than present known materials or combination of materials. Great promises frequently come across the Atlantic sent by enthusiastic newspaper correspondents. There is a little ground for these claims, but not much.

* "Motor Vehicles and Motors," pp. 394-439.

† "Proc. Inst. Civ. Eng." H. F. Joel, vol. clii.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 2...Farmers' Club, 2, Whitehall-court, S.W., 4 p.m. Mr. S. B. N. Druce, "The 1901 Census of England and Wales."

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. George Thudichum, "Bacterial Treatment of Sewage."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Mr. C. Napier Hake, "The Application of the X Rays to the Examination of 'Safety Fuses,'" and other papers.

British Architects, 9, Conduit-street, W., 8 p.m. Opening Address by Mr. Aston Webb.

East India Association, Westminster Palace Hotel, T. Durant Beighton, "The Modern History of Trial by Jury in India."

London Institution, Finsbury-circus, E.C., 5 p.m. Sir Arthur W. Rücker, "The work and aims of the London University."

TUESDAY, Nov. 3...Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Presidential Address by Sir William White.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Prof. W. B. Benham, "Some new Species of Aquatic Oligochæta from New Zealand." 2. Mr. Oldfield Thomas, "List of the Mammals collected by Mr. A. Robert at Chapadá, Matto Grosso." 3. Messrs. C. J. Gahan and G. J. Arrow, "List of the Coleoptera."

WEDNESDAY, Nov. 4...Geological, Burlington-house, W. 8 p.m. 1. Mr. E. H. Cunningham-Craig, "Metamorphism in the Loch Lomond District." 2. Mr. Henry Dyke Acland, "A New Cave on the Eastern Side of Gibraltar."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Sir Frederick Lugard, "Northern Nigeria."

THURSDAY, Nov. 5...Linnean, Burlington-house, W., 8 p.m. 1. Mr. L. A. Boodle, "Structure of the Leaves of the Bracken." 2. Mr. E. P. Stebbing, "Life-History of a new *Monophlebus* from India."

Chemical, Burlington-house, W., 8 p.m.

Junior Art Workers' Guild, Clifford's-inn-hall, Fleet-street. E.C., 8 p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. E. F. Jacques, "The Music of India."

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. H. T. Siccama, "Foundations."

FRIDAY, Nov. 6...Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. "Printing Types."

Architectural Association, 9, Conduit-street, W., 7½ p.m. Mr. C. A. Nicholson, "Modern Churches."

Geologists' Assoc., University College, W.C., 8 p.m. Conversazione.

Journal of the Society of Arts,

No. 2,659. Vol. LI.

FRIDAY, NOVEMBER 6, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ARRANGEMENTS FOR THE SESSION.

The First Meeting of the One-Hundred-and-Fiftieth Session will be held on Wednesday evening, the 18th of November, when an Address will be delivered by SIR WILLIAM ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., Vice-President and Chairman of the Council.

Previous to Christmas there will be Four Ordinary Meetings, in addition to the Opening Meeting. The following arrangements have been made :—

Wednesday Evenings, at 8 o'clock :—

NOVEMBER 18.—Opening Address of the CHAIRMAN OF COUNCIL.

NOVEMBER 25.—"The Universal Exposition at St. Louis, U.S.A., 1904." By GEORGE F. PARKER. The LORD CHIEF JUSTICE, G.C.M.G., Vice-President of the Society, will preside.

DECEMBER 2.—"Fiscal Reform." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B.

DECEMBER 9.—"Furnaces suitable for Jewellers' Work, Enamelling, Art Casting, and other similar Industries." By HENRY HARDINGE CUNYNGHAME, C.B.

DECEMBER 16.—"Science and Industry." By SIR WILLIAM HENRY PREECE, K.C.B., F.R.S.

INDIAN SECTION.

DECEMBER 10 (4.30 p.m.).—"India's Place in an Imperial Federation." By J. M. MACLEAN.

APPLIED ART SECTION.

DECEMBER 15 (8 p.m.). — "The British Silk Industry," by FRANK WARNER.

Papers for Meetings after Christmas :—

"Ice Breakers and their Services." By ARTHUR GULSTON.

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Organ Design." By THOMAS CASSON.

"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

"Artificial and other Building Stones." By L. P. FORD.

"Thermit." By PROF. CHARLES VERNON BOYS, F.R.S.

"Steam Motors." By THOMAS CLARKSON, M.I.Mech.E.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Mechanical Piano Players." By J. W. COWARD.

"The Presidency of Bombay." SIR WILLIAM LEE-WARNER, K.C.S.I.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday afternoons at 4.30 o'clock :—

December 10, January 11, February 11, March 10, April 28, May 12.

COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesday afternoons at 4.30 o'clock :—

February 2, March 1, April 12, May 3.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesdays at 4.30 or 8 o'clock :—

December 15, January 19, February 16, March 15, April 19, May 17.

CANTOR LECTURES.

The following courses of Cantor Lectures will be delivered on Monday evenings, at 8 o'clock :—

BENNETT H. BROUGH, "The Mining of Non-Metallic Minerals." Four Lectures.

LECTURE I.—NOVEMBER 23.—*Coals and Bitumens* :—Graphite—Coal—Brown coal—Peat—Petroleum—Ozokerite—Asphalt.

LECTURE II.—NOVEMBER 30.—*Salts :* — Rock-salt — Potash salts — Borates—Alums — Nitrates—Phosphates.

LECTURE III. — DECEMBER 7.—*Stone :*—Flint, Sandstone — Limestone — Marble — Dolomite — Slate — Eruptive rocks — Mica — Clays—Gypsum—Asbestos—Bauxite—Other earthy minerals.

LECTURE IV.—DECEMBER 14.—*Precious Stones :* —Diamond — Corundum Gems — Emerald — Other Precious Stones—Ornamental Stones—Rare Earths.

J. LEWKOWITSCH, PhD., M.A., F.I.C., "Oil and Fats—their Uses and Applications." Four Lectures.

January 25, February 1, 8, 15.

CHARLES T. JACOBI, "Modern Book Printing." Two Lectures.

February 22, 29.

BERTRAM BLOUNT, F.I.C., "Recent Advances in Electro-Chemistry." Three Lectures.

March 7, 14, 21.

The following course will be delivered on Monday afternoons, at 4.30 o'clock :—

LANGTON DOUGLAS, "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

April 25, May 2, 9.

JUVENILE LECTURES.

Two lectures, suitable for a juvenile audience, will be delivered on Wednesday Evenings, January 6 and 13, 1904, at 5 o'clock.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Monday afternoon, 2nd inst. Present :—Sir William Lee-Warner, K.C.S.I., in the chair ; Jervoise Athelstane Baines, C.S.I., Sir M. M. Bhownaggree, K.C.I.E., M.P., Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D., H. M. Birdwood, C.S.I., M.A., LL.D., F. C. Danvers, Sir Caspar Purdon Clarke, C.I.E., Colonel Sir Thomas Hungerford Holdich, R.E., K.C.M.G., K.C.I.E., C.B., Alexander Rogers, Carmichael Thomas, Sir Charles Cecil Stevens, K.C.S.I., W. Martin Wood, with Sir Henry Trueman Wood, Secretary of the Society, and S. Digby, Secretary of the Section.

The arrangements for the next session were considered.

Proceedings of the Society.

CANTOR LECTURES.

MECHANICAL ROAD VEHICLES.

BY W. WORBY BEAUMONT, Mem.Inst.C.E.

Lecture IV.—Delivered May 18th, 1903.

The wideness of the subjects that I have attempted to deal with in my previous lectures, has proved to me, at least, that it is absolutely impossible to go fully into particulars of many things I had hoped to deal with when I drew up the syllabus. I must therefore take up only a few of the remaining points, and give you a few illustrations, typical of many.

Our appreciation of the motor vehicle in this country has resulted in this. That not only is one of the manufacturing firms in this country turning out at least 500 cars per year, while at least three others are turning out from one to three hundred, but that we are exporting from abroad to such a very large extent, that for the first four months of this year we have bought something like £500,000 worth of cars and parts of cars from the Continent.* The industry has reached such proportions that now there are thousands of men whose labours and thoughts are occupied in producing this result.

The fact that it would take much more than these four lectures to give even a glance at the typical examples, and to deal with only a fraction of the points of the subject that are of most interest, gives some idea of the wideness of the field and greatness of the industry now being established on what, as compared with what may be expected in the future, is a small scale.

Without troubling you with views of the recent voiturette, I will refer to a few of those first made under this name, because their design had very important influence on the design of the larger vehicle. The Bollèe, which was brought out in 1896, was driven by a horizontal engine and belt. Modifications which have since been made in motors and in ignition would have made that vehicle a very much more satisfactory one. It was built too low, and the rider was too low, but its transmission could have been made remarkably efficient, and even as it is, the main ideas

* Since this it has been found that over a million sterling was spent by this country on foreign built cars and parts i the half year.

embodied in its gearing have been much copied.

A light car which perhaps has had more influence than any other on the design of the cars of to-day is the Renault, brought out in 1899.

It was the first car with a live axle and bevil wheel and pinion drive which had for its highest speed a straight through connection from crankshaft end to bevil pinion at the driving axle. A $3\frac{1}{2}$ horse-power De Dion motor was at first used.

The arrangement of the transmission gear was ingenious, simple, small and light, and has been the basis upon which many others have been designed since. The changing gears were mounted as excentric spindles, and the pinions were put into or out of mesh by radial instead of axial movement. Reversing was effected by bevil pinions, between a pair of which, a bevil wheel was forced into mesh.*

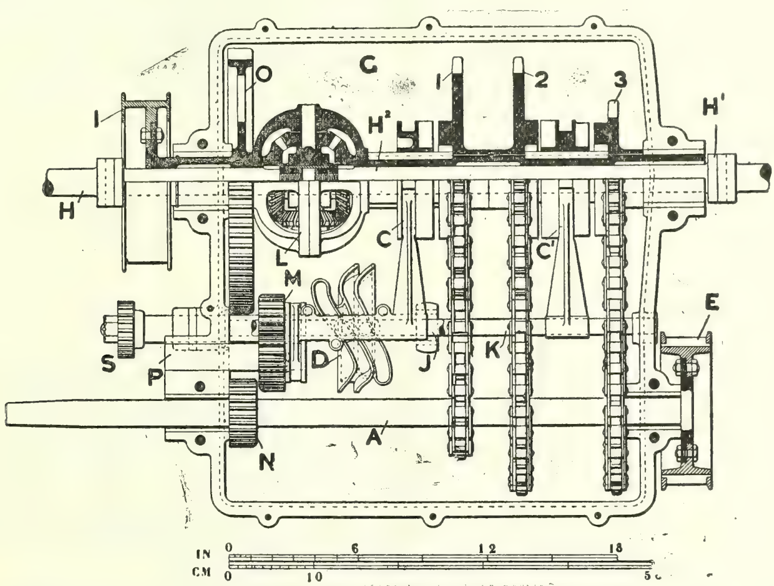
The Renaults have themselves improved upon the 1899 design, and have made many of the lightest and fastest cars of various powers, cars which have withstood the severest tests of long-distance races, including the wonderful run last year from Paris to Vienna, when Renault, on a 16 horse-power two-seated car, ran the whole racing distance of 615·5 miles at an average speed of 39 miles per hour for this long distance.

Motor bicycles had been made by several firms, some of them shown at the Imperial Institute Exhibition in 1896, but the form which promised most, as made by MM. De Dion and Bouton, was dropped as not likely to be much used, that firm being then of opinion that the motor tricycle would be the form preferred by the public. This has subsequently been proved to be a wrong opinion, but the De Dion tricycle caused the development of a wonderful little motor, at first of only $\frac{3}{4}$ horse-power, gradually growing to $2\frac{3}{4}$ horse-power. The great possibilities of these little motors, capable of running up to 2,000 revolutions per minute without flying to pieces, gradually forced themselves upon the attention of makers of the voiturette class until, as we have already seen, the combination of four such motors on one crankshaft, running at about 1,500 revolutions per minute, has been used for a large carriage of about 16 horse-power, or thereabouts.

The possibilities of these very high-speed motors have not even yet been exhausted, and MM. De Dion and Bouton were among the first to put them to use in the more ambitious work of driving a two and a three-seated voiturette.

Many hundreds of these voiturettes were

FIG. 27.



CHAIN DRIVEN SPEED CHANGE GEAR AND DIFFERENTIAL GEAR OF BROOKE CAR.

* "Motor Vehicles and Motors," p. 267.

made. The transmission gear was quite original, and, with the motor, was placed at the rear of the vehicle. The gear, as you see, gave two speeds put alternately into gear by the action of either of a pair of internal friction clutches. This gear is still used by this firm, but with some slight improvements and arranged to take the place of the more ordinary form of modified Levassor gear in carriages with the engine in front.

The number of different makes of light car driven by De Dion motors, or motors made from the De Dion designs by other makers, is probably not far short of a hundred in this country and on the Continent.

The car now known as the Gladiator began as a very light car driven by one of these small motors with a chain to a counter or intermediate shaft, and thence to a live axle by another chain. It was then very light and its mechanical efficiency was high. The car was, however, too lightly made and it is regrettable that the same design was not persisted in, but with greater strength throughout. The Gladiator afterwards came out with a 5 horse-power and afterwards 8 horse-power single cylinder De Dion motor, ordinary change gear and side driving chains. Subsequently the experience in the manufacture of very light cars has led the makers of the Gladiator, the Renault, the Darracq, the Decauville and others to get more and more power on the same frame, same wheels, and almost the same transmission gear.

The Argyll car is one which should also be specially mentioned as having a simple and novel form of change gear for three speeds, and with a through driver for the highest speed. This car has grown from a small light car to a larger and more powerful car.

The influence of the very light car or voiturette is seen in many other cars. The New Orleans car, up to 14 horse-power, with four cylinders, is the outcome of the little 3 horse-power Vivinus voiturette, with a little air and fan cooled motor, driving by belt a small countershaft and simple gear, a form of transmission which gave very good results when the belt was attended to, and would have been better with a larger slower-speed motor, and larger belt pulleys and belt. The present New Orleans cars are all gear-driven, with bevil gear on a live axle.

It may perhaps be thought that makers have now gone nearly as far as they are likely to go in crowding more and more power on very light vehicles, but when we look at the light racing machines of Darracq, Renault, and Decauville, we are less disposed to predicate a limit in this direction.

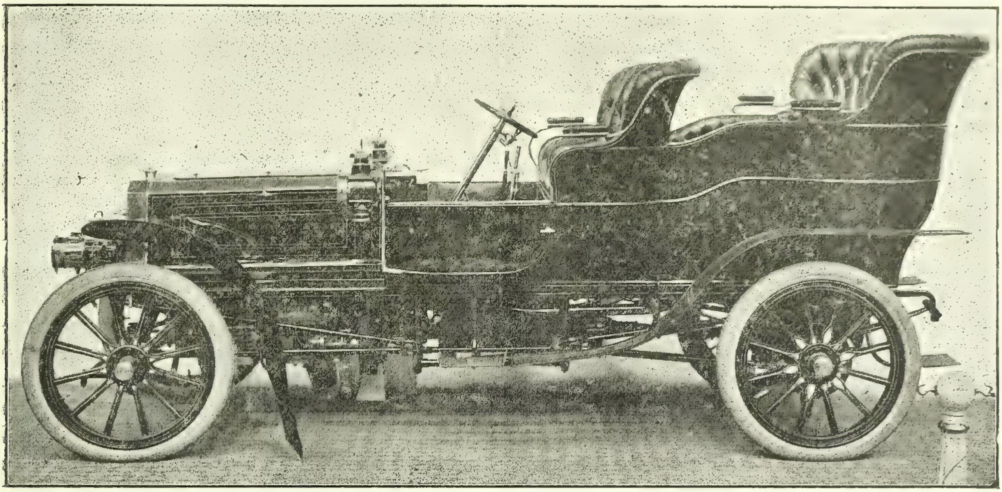
The view now before you shows an English built car, viz., the Brooke, which differs from any other. It was, I believe, the first made with a three-cylinder petrol motor, and is the only one in which the motion is conveyed from the intermediate motion shaft, driven by chain from motor, to the sprocket shaft by means of chains on the change speed gears running in a bath of oil, instead of using spur gear as is usual. When the very high efficiency of the bicycle chain is remembered, we can appreciate the fact that this gear runs not only quietly, but in an efficient and perfectly satisfactory way. It will be seen from Fig. 27, that there are three chains, and that either of the three pairs of wheels driven by them are put into gear, the one with the other, by means of the cam, marked D, which actuates the claw clutch moving arms C and C, for the three speeds. This type of transmission gear is not being used on the Brooke light car, which has the three-cylinder engine crank shaft placed fore and aft, and the more usual type of gear.

The next is a view of another English car, the Humber (Fig. 28) rated as of 20 horse-power, but capable of more than this. The motor has four cylinders $4\frac{1}{2}$ inch diameter and $5\frac{3}{4}$ inch stroke, and runs at about 1,000 revolutions per minnte. The view (Fig. 29) accompanying the car shows the transmission gear with the upper part of the box removed, and also the reversing wheel and pinion. The changes of speed are effected by sliding the gear wheels and pinions on a square spindle.

The next view (Fig. 30) shows another English built car, and one which has been very successful, that is a 10 horse-power Wolseley car, and differs in respect of the arrangement of the engine, the gearing, and the cooler, from any of the other cars that have been before us. It is a car that does not follow in any point any of the foreign designs. The engine has two cylinders, is horizontal, drives the intermediate spindle in the gear box by a wide silent chain, has no bevil gear, and has a water cooler in which the water is circulated by a pump driven direct by worm gear on the engine cam-shaft.

The next view will show you the gearing, an interesting part of the car. You have here the whole arrangement of the car mechanism, partly in section and partly in plan. The horizontal engine has cylinders, $4\frac{1}{2}$ inch diameter and 5 inch stroke, running normally at 750 revolutions

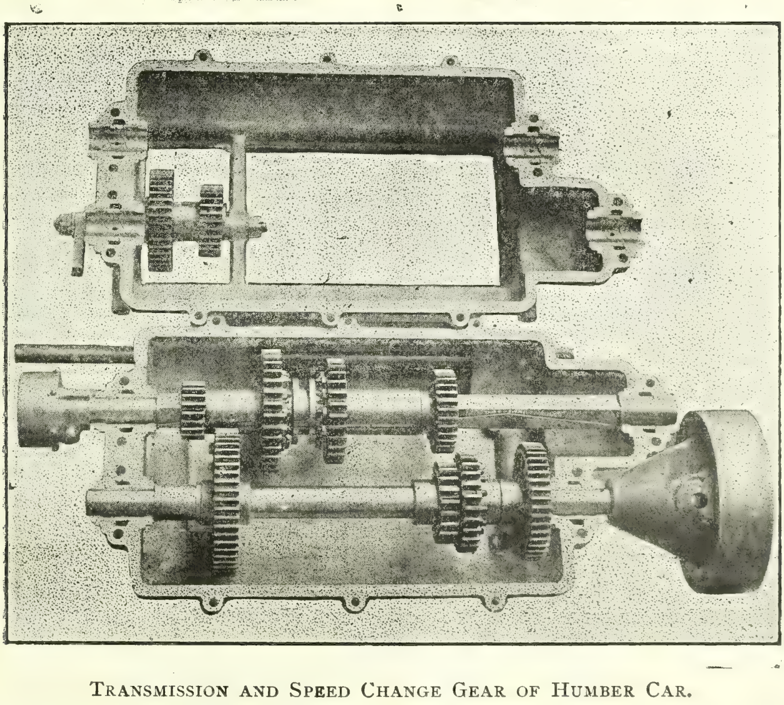
FIG. 28.



THE HUMBER 20 H.P. TOURING CAR.

per minute. That clutch, which is in the fly-wheel, can be adjusted as to the pressure, by which the interior part is forced into the exterior from outside the car, where the extension of the crankshaft is seen outside the frame. The power is transmitted from the engine by means of the silent chain running from this pinion Y, to the wheel, V. This drives the square shaft with the sliding pinions and spar wheels upon it for changing the speeds. Four different pinions and wheels, one of which, D, is also the differential gear.

FIG. 29.



TRANSMISSION AND SPEED CHANGE GEAR OF HUMBER CAR.

The reversing is effected by means of an intermediate wide pinion brought into play between the differentiated gear and the pinion shown near it. The proper distance between the sprocket shaft and the driving-wheel axle, a fixed axle, is maintained by a pair of rods centred upon the bearing of the sprocket-wheel shaft, and on the axle itself. There is thus not the least difference in the length between the sprocket-wheel and pinion, due to the play of the springs. These cars are well made and strong, and have during two succeeding years been awarded gold medals by the Automobile Club, as a result of the tests, or the durability trials conducted under its auspices.

The next view shows one of the Daimler 22 horse-power, precisely the same as that which has been recently supplied to the King. It is similar to that which is owned by several of the leading members of the Automobile Club, including the one owned by Mr. Henry Edmunds, which is fitted with a Bradley and Pidgeon clutch, which will be described hereafter.

The next views are of a 24 horse-power Panhard and Levassor car belonging to the Hon. C. S. Rolls, and of the under frame (Fig. 32) of the 10 horse-power car of the same manufacturers. From this latter you will see that they have not departed from the general arrangement associated with their name and with which splendid results have been obtained. They are not now using the Centaur carburetter, but the modified form known as the Krebs to which I referred last week. Chain drive to the road wheels is employed, and the transmission gear is of the sliding gear kind to which I have several times alluded. These cars are made in various sizes from 7 horse-power to 60 horse-power, and are very much liked.

Of the foreign cars those of Decauville are amongst those in which very great improvements have been made of late. One of these is seen in Fig. 34 which shows the under frame of the 16 horse-power car, a novelty and apparently an extremely good arrangement which is made only by the Decauville people. The whole of the forward parts of the side members of the frame are connected by a large dished plate carrying the whole of the machinery and firmly uniting the main parts of the frame and preventing any longitudinal deformation. This sheet of metal bed for the engine and gear box is only about $\frac{1}{8}$ inch thick, and holes are cut in it for the insertion of the gear box and engine crank case. Both the latter, however, are divided along the line of the plate, and the flanges by which the upper and lower parts of the gear box and of the crank chamber are connected clamp the plate between them. The stiffness of the cut plate is thus restored to it, and it provides all that is required to carry engine and gear with the advantage that the plate completely excludes all mud and dust that would otherwise arise from the road.

Another novelty in this car is the arrangement of the main axle, which, although a live axle driven by bevil gear, is nevertheless a fixed axle for the driving wheels. The fixed tubes within which the live axle runs are carried out to the necessary length for the wheels to run upon as on an ordinary axle. These tube ends carry the load, the live axle proper runs freely within them and they are extended to the outside of the wheel naves, where they are provided with heads which engage with the nose of each wheel and act as drivers, the live axle being only subject to torsional stress. The wheel naves have to be made rather larger than usual, and the wheels must be made strong enough to drive from the centre. These details, however, involve no difficulties.

The next view shows one of the new Velox petrol cars, a new car of English make and of 12 horse-power, fitted with a very handsome, roomy body. The Velox Company is making a pretty little car known as the miniature Velox.

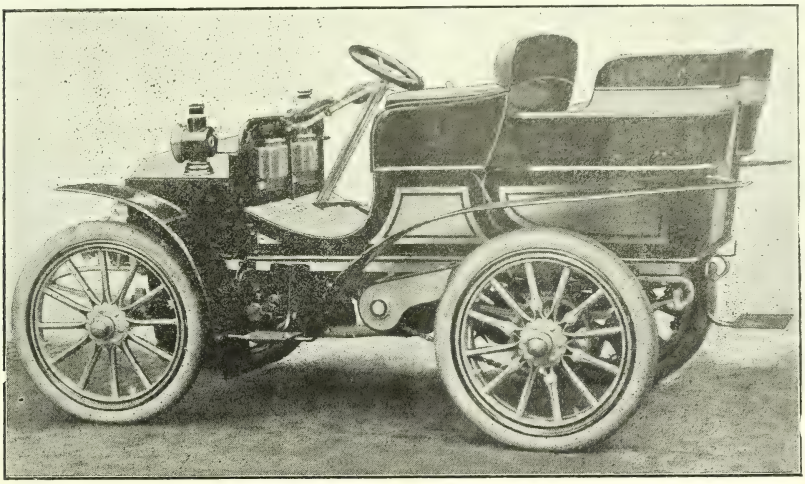
Turning now to another part of the subject, the view (Fig. 35) is one of the Thornycroft lorries for carrying from three to four tons. A difficulty experienced by the makers of these vehicles is to keep their weight down to the statutory limit of three tons. So long as the load to be carried is moderate, three tons tare limit is sufficient, but it is when the attempt is made to carry very heavy loads at the higher speeds of seven to ten miles per hour that the failure of everything that is not absolutely unbreakable comes and difficulties arise. The general arrangement of this lorry will be seen by the next view (Fig. 36), which shows the arrangement of the gear of the same sort of lorry or waggon, but for heavier loads, and with the boiler placed more forward, and over the axle instead of behind it.

These views show the form and arrangement, with slight modification, of waggons used in the War Office trials in December, 1901. Nearly all the vehicles for from three to five tons, for trading purposes, have been made with heavy

wood wheels, as designed by Hancock about 1830; but those which I have shown you have enormously strong metallic wheels, the spokes and centre being made of two large dished steel plate spiders, with the spokes cut out of the plate and put together with these spokes interlacing, and staggered at the angle steel rims to which they are rivetted with wide feet.

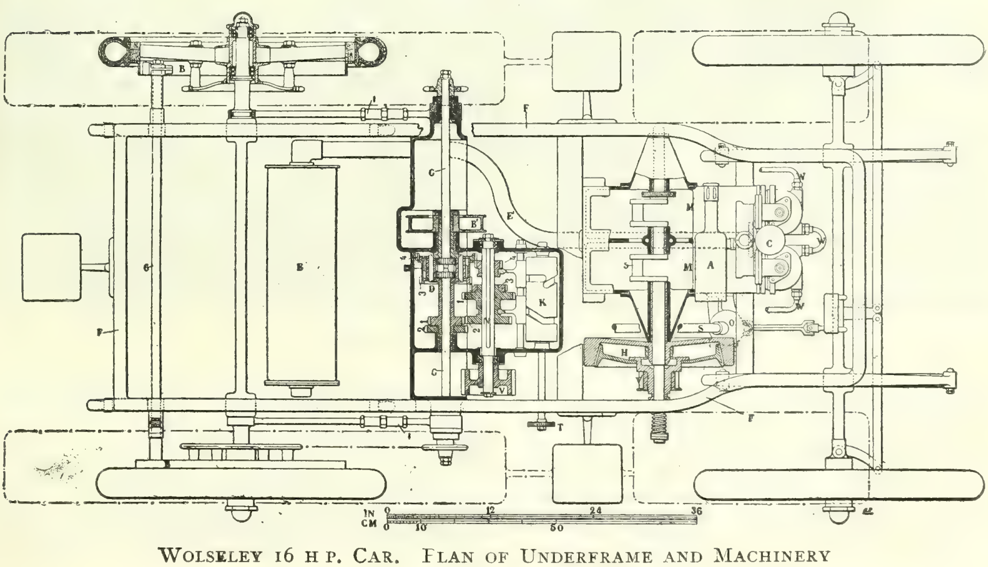
The view of the gearing (Fig. 36) is taken from beneath the vehicle. The gear is arranged for two speeds by sliding pinions on the extension of the crank shaft. These drive a short intermediate shaft in bearings which, like the engine, are fixed to the waggon frame. One end of this short shaft drives a jointed rod which gives motion to a pinion which drives a helical gear wheel on the differential gear and main axle. This arrangement of jointed shaft permits the main axle to move relatively to the lorry frame without affecting the running of the gearing attached to it. Numerous trials have been made with

FIG. 30.



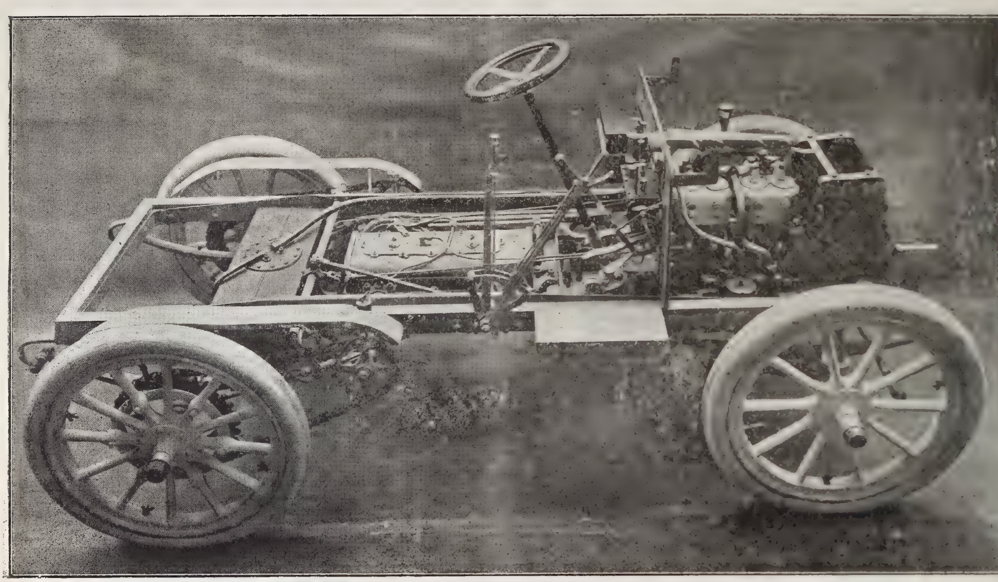
WOLSELEY 10 H.P. TONNEAU CAR,

FIG. 31.



WOLSELEY 16 H P. CAR. PLAN OF UNDERFRAME AND MACHINERY

FIG. 32.



PANHARD AND LEVASSOR CAR, 16 H.P. UNDER FRAME AND RUNNING GEAR.

these vehicles, and the results as to load carried and cost of transport can readily be found by those who want details in the reports published in the technical journals.* The War-office may equally be said to have shown that for the very heavy loads of seven tons or more the motor waggon itself becomes so heavy that for nearly all purposes one carrying a lighter load

FIG. 33.

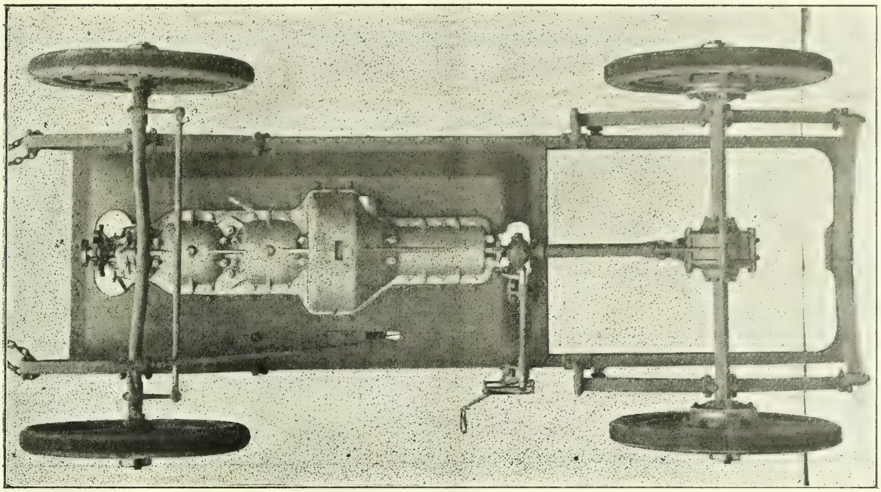
DECAUVILLE 16 H.P. TOURING CAR.

trials were severe and showed that the motor waggon as now made is capable of much moderately heavy continuous work, but they and hauling the remainder in a separate waggon is better, or a light tractor with a waggon or waggons.

The next views, Figs. 37 and 38, show the lorry and the tipping waggon made by Messrs. Coulthard and Co. In both these the boiler is placed

* *The Automotor Journal*, Nov. and Dec., 1901, pp. 47, 72, 100; Jan., 1902, pp. 139, 160. *The Autocar*, 14 Dec., pp. 582, 594. *The Engineer*, 13 Dec., pp. 601, 606.

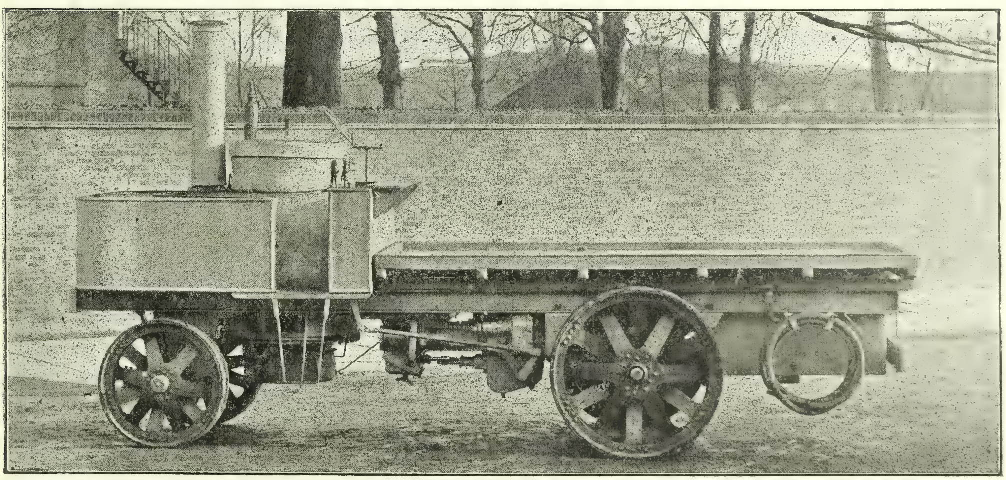
FIG. 34.



FRAME AND GEAR CASE OF 16 H.P. DECAUVILLE CAR. VIEW FROM UNDERNEATH.

behind the front axle and the driver sits and stokes and steers in front of it, and behind the water tanks and bunkers. Heavy wooden wheels are used by Messrs. Coulthard and Co. for these vehicles. The supplementary water tank which is in the rear of the underneath part of the lorry, is, in the tipping waggon, placed immediately behind the boiler, so that the heavy weight of it partly balances the load in the tip waggon, and does not add to it on the hind wheels. The engine and gearing in these waggons are, except the driving chain, completely enclosed. Messrs. Coulthard and Co. have made a large number of these lorries and waggons, and have proved their powers in the trials conducted by the Liverpool branch of the Automobile Club*, and in trials in America where they gained a first prize.

FIG. 35.

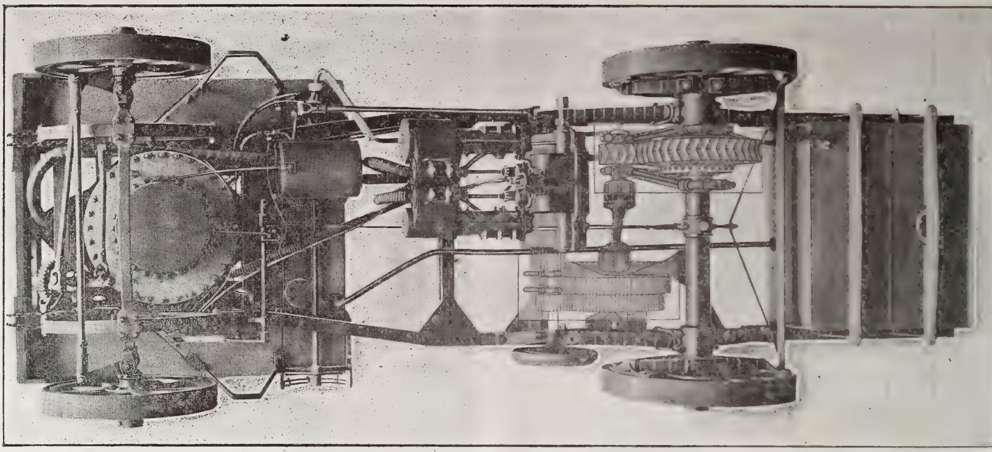


THORNYCROFT STEAM LORRY, 3-4 TONS.

Two other heavy motor-waggons of quite different types are shown by Figs. 39 and 40. The

* "Report of Trials," 1901.

Fig. 36.



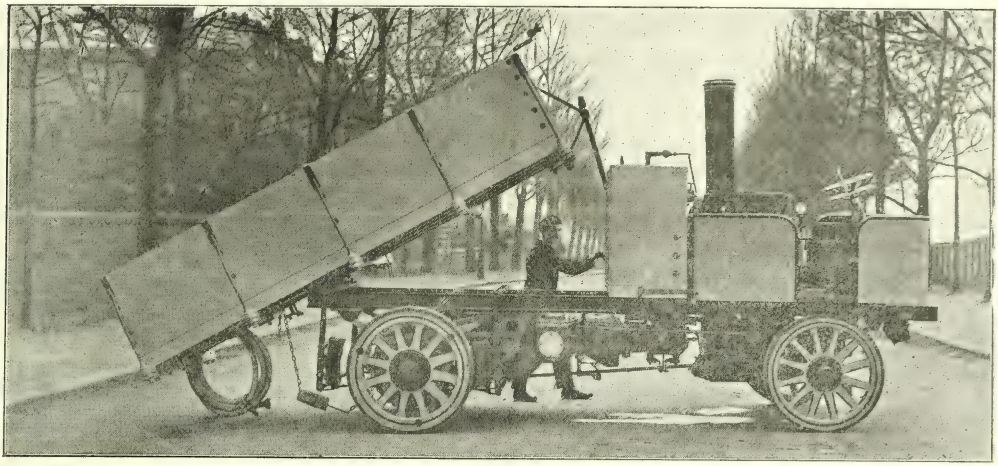
Thornycroft Steam Lorry. View of Boiler, Engine, and Gear from beneath.

former shows the waggon or lorry as made by the Yorkshire Steam Waggon Company, Leeds. In this a novel boiler, placed over the front axle, is used. It has a central locomotive type fire-box, and from the upper part of this has, on either side transversely, a very short loco barrel with short tubes, and a smoke-box and door at either side, one of which is seen in the figure. The lower tubes take the products of combustion into the smoke-boxes, and the upper tubes deliver them into a central uptake. The doors are made approximately air-tight, and the exhaust steam from the engine is heated in pipes in the smoke-boxes, and is

Fig. 37.

The Coulthard Steam Lorry, 3-4 Tons.

FIG. 38.

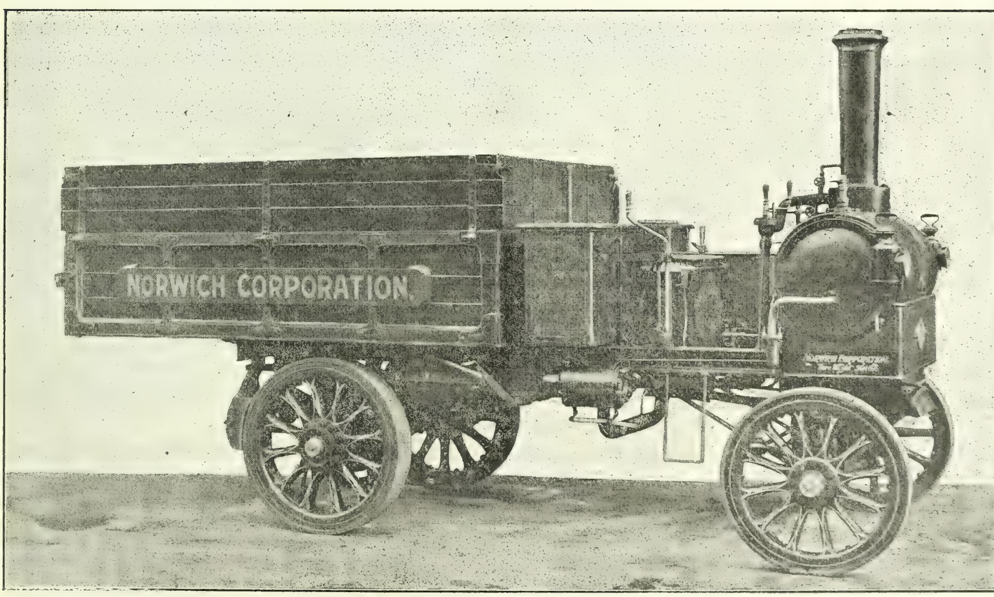


THE COULTHARD STEAM TIPPING WAGGON.

sent through jets into the upper tubes on its way to the central uptake, where it is delivered sufficiently superheated to pass away generally unobserved. Two single cylinder engines are employed, one on either side as seen, and on one crankshaft, which drives an intermediate shaft by spur gear, with two speed changes, and this shaft conveys motion by gear to the driving axle.

The second view shows a tipping-waggon made by the Manns Steam Cart and Waggon Company, Leeds. This, it will be seen, is a modified traction-engine, with locomotive boiler, but with the engine and gear enclosed, and placed behind the fire-box, the fire door of which is at the side shown, where there is also the seat and foot plate for the driver. A peculiarity of this waggon is the arrangement

FIG. 39.



THE YORKSHIRE STEAM WAGGON COMPANY'S LORRY, 3–4 TONS.

of the rear road wheels. On the permanent or boiler and engine part of the waggon is a pair of road wheels driven by the engine and gear. These are narrow wheels but of sufficient width for the weight without the waggon. The latter has its own wheels which are carried by horn plate brackets and short axles, the wheels when in place as shown being coincident with the engine wheels. When in place the wheels are connected, and there is thus a very wide wheel to carry the full load, but the waggon can be readily detached and a loaded one connected.

Besides the heavy vehicles shown there are also the Straker waggon similar to that which was awarded one of the War Office trials prizes; the Lancashire Steam Waggon Company's lorries and waggons; and others of recent origin.

With the next view we turn to a different type of vehicle, namely, a motor omnibus, one of those which have been the most successful hitherto and which promise to be successful in the future. It is a petrol motor omnibus made by the Connstett-Daimler Co., and known here as the Milnes-Daimler. In nearly all cases hitherto omnibus motor companies have attempted to carry too many passengers and at too high a speed for commercial success. I will not, however, repeat my views now concerning motor omnibuses and the necessary conditions for success. The vehicle shown by Fig. 41 is one of the kind successfully running between Manchester and Preston, carrying the mails, and as omnibuses at Hastings, Eastbourne, West Penrith, Cornwall, and Penzance. They are fitted with four cylinder Daimler motors and with magneto machine ignition apparatus. There is no doubt that we have arrived at a vehicle which might be commercially successful if used under proper conditions.

The next slide relates to another subject, namely, the effect of high speed on curves. Only last week in some of the several illustrated journals dealing with automobilism there was a view of a car in a ditch by the roadside, the result of taking a curve at too high a speed. The late Count Zborowski met his death through attempting even a moderate curve at too high a speed. Many have found themselves on two wheels instead of four in taking a sharp curve at a high speed. I therefore thought it would be interesting to show what might be the speeds on the one hand at which vehicles would begin to skid on being turned from a straight path, and, on the other, at which vehicles would be liable to overturn. The diagram (Fig. 42) gives these speeds and curve radii.

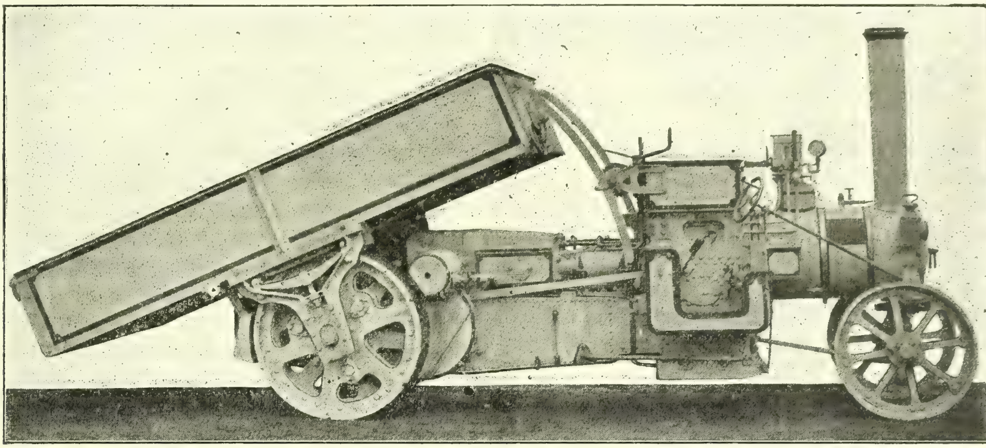
The ordinates give the radii of curves in feet, and the abcissae the limiting speed in miles per hour. In calculating these curves a coefficient of adhesion of the rubber tyres of 0·66 was employed; but it was mentioned that with roads in a dusty condition this coefficient might be materially reduced. With roads in a greasy condition the slipping, of course, would be almost incapable of calculation, and would commence at very much smaller curvatures than those given. From the curve it will be noticed, as was mentioned earlier in the lecture, that with the road in good condition for rubber adhesion a car going at a speed which it is said the late Count Zborowski was travelling when his accident occurred, would skid when turned from a rotolinear path to a curve of about 300 feet in radius. On the other hand it will be seen from the curve that at, say, thirty miles per hour, a car would skid when turned from the straight path to a curve of 90 feet radius. For the calculation of the overturning curve a wheel-gauge of 4 ft. 6 in. was adopted, and an assumed height of centre of gravity was taken of 2 ft. 6 in. from the ground.

On these assumptions it will be seen that the overturning moment is reached long after the skidding has begun, overturning for instance commencing on a curve of about 18 feet radius at a speed of 30 miles per hour. If the roads were flat skidding would have continued, and at the speeds whereat skidding takes place overturning would not occur unless the wheels on the outside of the car met some obstruction, as, for instance, a rise in the road, or by contact with kerb or pathway edges. With the higher centre of gravity of some cars the overturning moment would be reached much earlier.

In referring to the 20 horse-power Daimler carriage, I referred to a new form of clutch fitted to one of these carriages by Messrs. Bradley and Pidgeon for Mr. Henry Edmunds. This being a novel and successful application of the principle of the Weston friction clutch, I have prepared a diagram of it (Fig. 43).

In this A is the motor crankshaft, and B the fly-wheel upon it. Within this is the disc C, taking the place of the internal cone of the ordinary clutch. Between the inwardly projecting flange C′, of this disc and the inside of the fly-wheel rim is a series of flat rings, 48

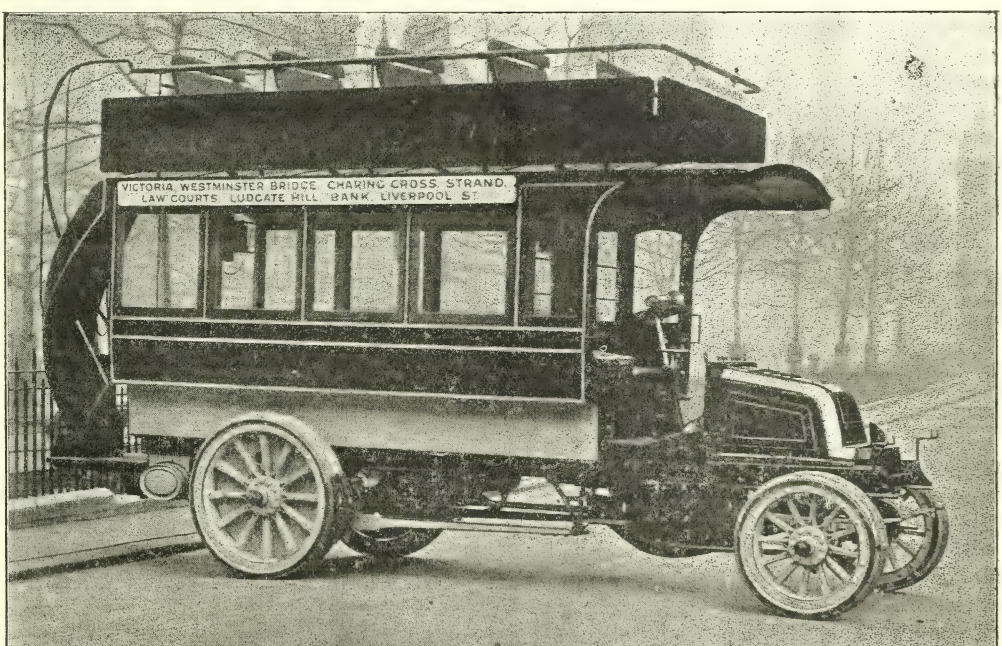
FIG. 40.



TIPPING WAGGON. MANN'S STEAM CART AND WAGGON CO., 4-5 TONS.

in number, and not more than 1-16th of an inch thick, half of them carried by the pins D, and the other half by the pins D′, the latter being fast in a ring, F, at one end, and in the ring periphery of the spider, E, at the other. Equidistant round the clutch are eight springs, S, adjustable as to the pressure they exert by the screw and nut upon the pins carrying them. The springs press the spider and ring E, outwards, and thus by the pins D′, and ring F, press the friction plates together. When it is necessary to release the clutch, the centre G, of the spider is pressed toward the clutch by pedal connection not shown. By lightly

FIG. 41.



MILNES-DAIMLER MOTOR OMNIBUS, 16 H.P.

pressing the pedal and partially relieving the series of thin rings of the pressure upon them the clutch may be made to give a slipping drive of from a few foot-pounds to the full power of the motor.

The clutch as already shown is also provided with reversing gear. The fly-wheel carries a pair of pinions J and J′, gearing respectively with a pinion K, on the end of the driven shaft A′ and H, on the inside of the disc C. If C be held by a band on the projecting rim C′, the pinion J, rolls round H and J′, being fixed to J, and being a little larger than it, drives the shaft A′ in the opposite direction to that of the fly-wheel and at a very slow speed.

I have referred to several cars as being fitted with live axles as distinguished from the fixed axles upon which the driving wheels run as they do in ordinary vehicles. Most of these live axles are in two parts, each part being driven by one-half of the differential gear. These two parts of the axle generally run in a tubular extension of the differential gear case and its bearings, and the tube ends are attached to the springs after the manner of an ordinary fixed axle. The ends of the internal live axle project from bearings either plain or ball bearings at the ends of the tubes. Upon the live axle ends the driving wheels are fixed. Near the bearings these axles sometimes break, but sometimes this has been due to a sudden change of diameter at these parts. To avoid the defects of the live axle so constructed, the tubular fixed axle has in some cases been extended as with one car already mentioned, and the wheel naves made large enough to run upon them.

One such arrangement is shown by the view now before us (Fig. 44), as used in the recent New Orleans cars. In this the tubular fixed axle A, fixed to the springs, as at B, contains the live axle E, the end of which is squared, and on it is fixed the nose of the wheel hub D, which has upon it the brake drum G. With this arrangement it will be seen that the load upon the wheel is carried by the fixed tubular axle, the live driving axle being subjected to the torsional stress of driving only, and not to the ever-changing direction of stress of a revolving load-carrying axle.

A car to which I have not yet referred is the Maudslay car, an English car with several features of much interest. The view now before you shows the arrangement of the valve operating gear. The whole of the valves are operated by the one cam spindle, to which motion is given by a jointed driving rod and bevil gear. The cam spindle bearings are all mounted in one pivoted carrier, which by slacking off three eye bolts can be turned back away from the valve heads, so that all valves are immediately accessible without removing any pipe joints or connections. The engine has three vertical cylinders, this and the Brooke car being the only car using three cylinder engines.

During the past seven years the tendency in design of motor vehicle machinery has been towards simplification so far as some of the elementary details and pipe connections are concerned; but as the cars have grown in power, this fact has been masked by the greater number of parts and by additional devices for effecting ignition of the charge in the cylinder. Within the past year also it has become common to believe that the mechanical operation of the inlet valve secures advantages which are not too dearly paid for by the additional parts necessary. It is true that some of the most economical runs on trials by expert drivers have been made by one or more cars thus fitted, but if one instance and one car is not included in the survey, it will be found that on a long run the question as to economy remains an open one, although by hypothesis, the engine with mechanically-moved valves might be expected to give the slightly higher results. It is not, however, at all clear that the best use has been made in many engines of the automatic valve, and the downwardly opening valve may not lend itself to the best results.

It is noteworthy that the miles covered by a car carrying four persons is little if any greater to-day per gallon than in 1899. Several vehicles of the English Daimler and the Cannstatt-Daimler makes, and the Mors and the Delahaye car made an average of 28·5 miles per gallon in the trials carried out by the Automobile Club. Even allowing for expertness in the driving and the slow average speed of the then low powered cars, this does not support the idea that very great economy has been secured by more recent designs. It is true that the greater relative consumption by the higher powered cars of to-day may be in great part accounted for by the greater work done in the time through the greater speed adopted, and this is supported by the fact that the 8 horse-power Panhard and Levassor car driven during the Richmond trials gave only 22·2 miles per gallon carrying only two, or half the number of passengers carried by the cars

that gave 28·5 miles per gallon. Moreover it must be remembered that some of the 1899 cars run on solid rubber tyres.

Since 1899 pneumatic tyres have become almost universal for pleasure cars. With the increase of speed for which so many people crave, and which is exhilarating to nearly all, the difficulties and the costs all grow rapidly. The higher the speed the greater the power required, the greater the number of parts, two cylinders grow to four, the governing and controlling and ignition connections multiply, the strength of many parts must be increased, the petrol and oil and grease con-

FIG. 42.

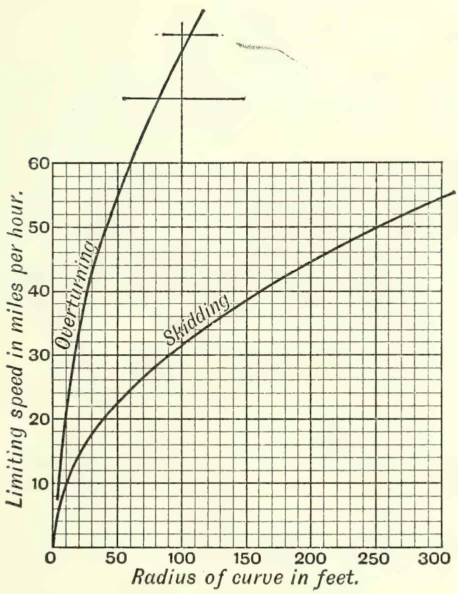


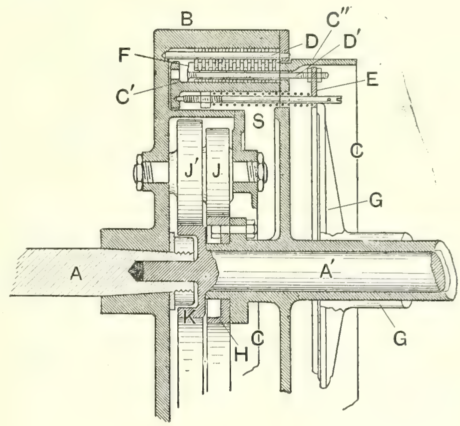
DIAGRAM SHOWING LIMIT TO SPEED ON ENTERING CURVES.

sumption increases, and finally the pneumatic tyre becomes an essential and a costly one; and, finally, there is another and a heavy cost, namely occasional forced contribution to the rates, or wherever the fines go to when extorted on a technical breach of the speed law. Speed, however, is not always the cause of this last expense, it is sometimes the word of magisterial persecution in which there is no truth, and sometimes it is the penalty of slow speed and obedience to servants demoralised by servitude under unjust and interested magistrates who put a heavy load of prejudice in one of what ought to be the evenly balanced scales of justice.

With low speed, solid tyres would be sufficient with well-designed and well-made springs, and the cost, direct and indirect, would be considerably reduced, for the solid or cushion tyre would afford sufficient cushion to the many parts which are destroyed by severe shaking at higher speeds.

All these things point to one thing, viz., the

FIG. 43.

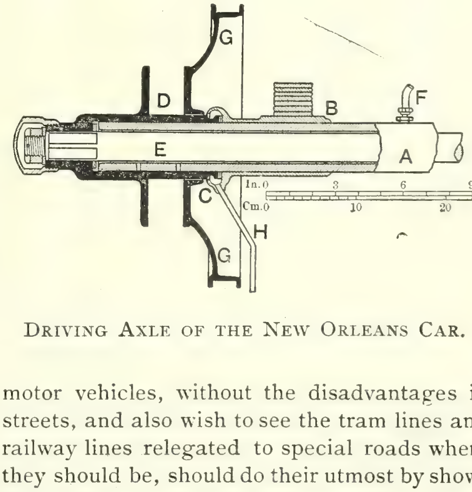


THE BRADLEY-PIDGEON FRICTION CLUTCH.

importance, as I have so long urged, of getting every one to recognise the fact that the only reason for putting down tram lines, or making really good roads, is to get low traction resistance.

Those who wish to see the advantages of

FIG. 44.



DRIVING AXLE OF THE NEW ORLEANS CAR.

motor vehicles, without the disadvantages in streets, and also wish to see the tram lines and railway lines relegated to special roads where they should be, should do their utmost by showing that the motor vehicle question is a road

question, one which if properly understood would secure economy in vehicle maintenance, and even in the price of articles of daily consumption. Our roads are in many places, and especially in London, badly maintained. After being made or remade at great cost, they are allowed to go without the least attention or intelligent repair, until they are so bad again that they must be remade at very great cost. It is to me one of the most astounding things I know of, that the hundreds of thousands of vehicle and horse owners should remain so utterly helpless as they do, in a matter which causes destruction of their vehicles and their horses, as well as great discomfort. They seem to take badness of road maintenance as they do thunderstorms, as things over which they have absolutely no power. Yet by intelligent combination they might always have good road surfaces, and might secure the advantages which are only partly secured to them by the use of rubber tyres, and costly arrangements of springs. Rubber tyres are only necessary as palliatives of the effects of badly maintained road surfaces which cost more—more rates—than good road surfaces would do.

Improvement of the roads all over the country is one of the greatest necessities in view of existing and growing traffic requirements, and it is gratifying that attention is being given to it, largely through the action of the Roads Improvement Association.

With regard to the various forms of engines or motors, it would seem that the internal combustion motor is likely to retain the place which it has now among the different forms of motor for propelling vehicles. On the other hand, there can be little doubt that the field of the electrically-propelled vehicle is one that will rapidly widen. The electric motor, as applied in this direction, would, however, form a subject for more than the four evenings which I have at disposal, but we can already see that there is a limit which will affect the electric vehicle, and leave the others in the position which they now relatively occupy.

A very important direction of development, one which I have for some years urged, lies in the development of the simplest arrangement of motor and gear which will best suit the parcels and light vehicles, for loads from 5 cwt. up to about 25 cwts.

With regard to the omnibus of the future we have not only the promising petrol motor vehicle but there is the electrically propelled omnibus operated by a current received from a wire, either overhead or by the side of the road, as is the case with the tramways. The vehicle to find its own way among and accommodate other traffic and to run at a moderate rate. It has all the advantages of the tramways without any of their numerous disadvantages. It has been in use near Berlin along a line for which the materials were supplied by Siemens and Halske. It has the very great advantage of requiring no tram rails in the streets, but of course like other vehicles it will work best on good roads.

There is one thing to be repeated as to the motor waggon for heavy traffic. These vehicles are said to be the requirements of great manufacturing centres. If, however, the motor waggon for carrying heavy loads is to be successful for distributing goods mainly on the same roads day by day we shall have to meet these vehicles half way, and recognise the necessity for tram plates which will not interfere with other traffic, or tramways of some form off the beaten track of other traffic, so that the motor waggons shall be able to run from docks and railway stations to the mills or other loading or unloading destinations.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 9...Surveyors, 12, Great George-street, S.W., 8 p.m. Opening Address by the President, Mr. Albert Buck.
London Institution, Finsbury-circus, E.C., 5 p.m. Dr. J. A. H. Murray, "The World of Words and its Explorers."

TUESDAY, Nov. 10...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Prof. W. C. Unwin, "Tensile Tests of Mild Steel, and the Relation of Elongation to the size of the Test-Bar."
Colonial Institution, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Major Ronald Ross, "Malaria and the Colonies."
Geographical, University of London, Burlington-gardens, W., 8½ p.m. Commander R. E. Peary, "North Polar Exploration, 1898–1902."

THURSDAY, Nov. 12...London Institution, Finsbury-circus, E.C., 6 p.m. Mr. F. T. Bullen, "The Merchant Service."
Electrical Engineers, 25, Great George-street, S.W., Inaugural Address by the President, Mr. R. K. Gray.

FRIDAY, Nov. 13...North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m.
Physical, Royal College of Science, Exhibition-road, South Kensington, S.W., 8 p.m. Sir Oliver Lodge, 1 (*a*), "Means for Electrifying the Atmosphere on a large scale;" 2 (*b*), "An Arrangement for Driving Mercury Pumps."

Journal of the Society of Arts,

No. 2,660. Vol. LI.

FRIDAY, NOVEMBER 13, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ARRANGEMENTS FOR THE SESSION.

The First Meeting of the One-Hundred-and-Fiftieth Session will be held on Wednesday evening, the 18th of November, when an Address will be delivered by SIR WILLIAM ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., Vice-President and Chairman of the Council.

Previous to Christmas there will be Four Ordinary Meetings, in addition to the Opening Meeting. The following arrangements have been made :—

Wednesday Evenings, at 8 o'clock :—

NOVEMBER 18.—Opening Address of the CHAIRMAN OF COUNCIL.

NOVEMBER 25.—"The Universal Exposition at St. Louis, U.S.A., 1904." By GEORGE F. PARKER. The LORD CHIEF JUSTICE, G.C.M.G., Vice-President of the Society, will preside.

DECEMBER 2.—"Fiscal Reform." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B.

DECEMBER 9.—"Furnaces suitable for Jewellers' Work, Enamelling, Art Casting, and other similar Industries." By HENRY HARDINGE CUNYNGHAME, C.B.

DECEMBER 16.—"Science and Industry." By SIR WILLIAM HENRY PREECE, K.C.B., F.R.S.

INDIAN SECTION.

DECEMBER 10 (4.30 p.m.).—"India's Place in an Imperial Federation." By J. M. MACLEAN.

APPLIED ART SECTION.

DECEMBER 15 (8 p.m.).— "The British Silk Industry," by FRANK WARNER.

Papers for Meetings after Christmas :—

"Ice Breakers and their Services." By ARTHUR GULSTON.

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Organ Design." By THOMAS CASSON.

"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

"Artificial and other Building Stones." By L. P. FORD.

"Thermit." By PROF. CHARLES VERNON BOYS, F.R.S.

"Steam Motors." By THOMAS CLARKSON, M.I.Mech.E.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Mechanical Piano Players." By J. W. COWARD.

"The Presidency of Bombay." By SIR WILLIAM LEE-WARNER, K.C.S.I.

"Agricultural Education." By J. C. MEDD.

"Garden Cities." By A. R. SENNETT.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday afternoons at 4.30 o'clock :—

December 10, January 11, February 11, March 10, April 28, May 12.

COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesday afternoons at 4.30 o'clock :—

February 2, March 1, April 12, May 3.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesdays at 4.30 or 8 o'clock :—

December 15, January 19, February 16, March 15, April 19, May 17.

CANTOR LECTURES.

The following courses of Cantor Lectures will be delivered on Monday evenings, at 8 o'clock :—

BENNETT H. BROUGH, "The Mining of Non-Metallic Minerals." Four Lectures.

LECTURE I.—NOVEMBER 23.—*Coals and Bitumens :*—Graphite—Coal—Brown coal—Peat—Petroleum—Ozokerite—Asphalt.

LECTURE II.—NOVEMBER 30.—*Salts* :—Rock-salt—Potash salts—Borates—Alums—Nitrates—Phosphates.

LECTURE III.—DECEMBER 7.—*Stone* :—Flint, Sandstone—Limestone—Marble—Dolomite—Slate—Eruptive rocks—Mica—Clays—Gypsum—Asbestos—Bauxite—Other earthy minerals.

LECTURE IV.—DECEMBER 14.—*Precious Stones* :—Diamond—Corundum Gems—Emerald—Other Precious Stones—Ornamental Stones—Rare Earths.

J. LEWKOWITSCH, PhD., M.A., F.I.C., "Oil and Fats—their Uses and Applications." Four Lectures.

January 25, February 1, 8, 15.

CHARLES T. JACOBI, "Modern Book Printing." Two Lectures.

February 22, 29.

BERTRAM BLOUNT, F.I.C., "Recent Advances in Electro-Chemistry." Three Lectures.

March 7, 14, 21.

The following course will be delivered on Monday afternoons, at 4.30 o'clock:—

PROF. R. LANGTON DOUGLAS, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

April 25, May 2, 9.

JUVENILE LECTURES.

Two lectures, suitable for a juvenile audience, will be delivered on Wednesday Evenings, January 6 and 13, 1904, at 5 o'clock.

ART WORKMANSHIP PRIZES.

In 1902 the Council of the Society offered three prizes amounting in the aggregate to fourteen guineas to the Northampton Institute, Clerkenwell, E.C., to be awarded for Art Workmanship among the students of the Institute. These prizes were provided by the accumulation of interest on a sum of £157 presented by the Committee of an Exhibition held in North London in 1865, with a view to the award of such prizes.

The Governors of the Institute have recommended that the prizes be awarded as follows, and their recommendation has been adopted by the Council of the Society of Arts:—

First Prize—£7 7s., to A. J. Downey, for a Bookplate.

Second Prize—£4 4s., to S. F. Briault, for a Specimen of Chasing.

Third Prize—£3 3s., to F. C. Latter, for a Frieze.

The Council have offered to provide similar prizes for a future year.

COLONIAL SECTION.

A meeting of the Committee of the Colonial Section was held on Wednesday afternoon, 11th inst. Present: Sir Westby B. Perceval, K.C.M.G., in the chair; Lord Belhaven and Stanton, Hon. Sir John Cockburn, K.C.M.G., Hon. Sir Charles Fremantle, K.C.B., Robert Kaye Gray, Alexander Siemens, Sir John Smalman Smith, M.A., Earl of Stamford, with Sir Henry Trueman Wood, Secretary of the Society, and S. Digby, Secretary of the Section.

The arrangements for the next Session were considered.

THE AGRICULTURAL AND INDUSTRIAL CONDITION OF VENEZUELA.

The agricultural wealth of Venezuela depends upon the cultivation of coffee. Cocoa is another source of wealth, the product obtaining remunerative prices in European markets in view of its very superior quality. Arabian coffee is generally cultivated; it was introduced in 1784 from Martinique, where it had been brought in the beginning of the century. The Venezuelan planters in recent years have been experimenting with the Abyssinian coffee, and have obtained very good results. The general area of the coffee plantations is estimated at about 420,000 acres. The total production is placed at 850,000 bags of 100 pounds. This production is very small as compared with that of Brazil, the State of San Paulo alone producing 6,000,000 bags. Havre, the great market for Venezuelan coffee, has been closed to it for some time past on account of the application of a prohibitive customs duty. It is now sent to Hamburg and New York. According to the Belgian *chargé d'affaires* at Caracas, the country consumes about 200,000 bags of its produce and exports 650,000, while 200,000 bags of Columbian coffee are exported annually through the port of Maracaibo. The coffee in Venezuela is gathered in the same manner as the Brazilian crop, and the machinery used for its industrial manipulation is of English, American, or Dutch make, but these agricultural installations are as yet very rudimentary and leave much to be desired. Two grades of cacao are found in Venezuela—*criollo* cacao, which is the native cacao, and the *trinitario* cacao, which was imported from Trinidad. The *criollo* grows wild in the valleys situated near the sea, where the temperature is warm and moist. It is of a very good quality. The most important plantations are found between La Guayra and Puerto Cabello. The *trinitario* is inferior in quality to the *criollo*, but it grows more rapidly. This cacao is extensively planted at present, and although it is bitter in taste compared with the *criollo*, it is readily sold. The average annual

crop of Venezuelan cacao is about 8,000 tons. Tobacco grows in the warm and temperate regions. It is planted from August to November, and gathered towards the month of May. The places of production are Barinas, Barquisimeto, Coro Capadare, Maturin, Guanape, &c. The tobaccos of the last three places are most in use. Capadare furnishes the best quality; Maturin tobacco is of inferior quality. These tobaccos are divided into three classes, according to the size and beauty of the leaves, and their special conditions of colour, strength, taste, perfume, &c. The Venezuelan tobacco has a bitter taste. Tobacco imported from Havana, where it is known under the name of Vuelta Abajo, is now being cultivated at Perija, near Maracaibo. Rubber grows abundantly in Venezuela, and is found especially in the Orinoco basin. Several foreign companies—German, American, French, and Belgian—have been organised in recent years for working this valuable product. In 1901, more than 1,000 tons of rubber were exported from Venezuela. Cotton and indigo are scarcely cultivated in Venezuela at the present time. The consumption of bananas is very large, as in all tropical countries, but they are not exported, although a direct line of navigation connecting La Guayra, Puerto Cabello, and Maracaibo, with the United States would, it is said, contribute to the success of the export trade in this produce. Sugar-cane is widely cultivated. According to the last census, of a general total of 49,462 haciendas, 11,020 were devoted to the exploitation of the cane, of which there are two varieties, the *cana criolla*, or native cane, and the *cana de otaïti*, or of the South seas. This latter variety is stronger, taller, more easily cultivated, and contains a larger percentage of sugar. In central Venezuela, in the valleys of the Tuy, Aragua, Lake of Valencia, &c., the cane is prepared in large mills, which are run by steam. In the Cordilleras the mills are much more primitive. The products obtained are, with the exception of a small exportation, all consumed in the country. Brown lump sugar, *papelon*, is the most important product. The enormous quantity consumed is only equalled by that of the cane, *aguardiente* (cane spirit), the most profitable resource of the sugar-cane planters. A part of the raw sugar is refined, and gives a fine white crystallised sugar which is consumed by the wealthier classes. The vast forests which cover Venezuela, contain all the fine tropical woods. The small exportation of Venezuelan woods, which scarcely amounts to 4,000 tons a year, is due to the lack of labour, and means of communication. In the exports, mahogany, ebony, lemon, and orange woods figure for only a small part, while ironwood (*vera*), *guayacan*, and *zapatero* form almost the entire amount. The State of Lara, owing to its salubrious climate, more numerous population, and to the railway line from Barquisimeto to the port of Tucacas, which crosses the State, is the most accessible of the forest regions. Cattle breeding, which was formerly very profitable, has decreased considerably of late years. At the present time the number of large cattle in the country is estimated at 2,000,000 head. Caracas and the suburbs consume 6,000 per month. The exports are shipped principally through the ports of Puerto Cabello and Guanta. Puerto Cabello ships from 50,000 to 60,000 head annually, which are all destined for Cuba. There is only one *saladero*, or packing house, in Venezuela. Leather manufacturing is the principal native industry, all the raw material being found in the country. The hides are furnished by the large troops of llamas, sheep, and goats of the States of Lara and Falcon. The tanning barks are obtained from myrobalam, mangle, dividivi, and quebracho, from the forests of the Orinoco and the Zulia. About the middle of the century, some European workmen—Italians and Spaniards principally—established a shoe factory in Caracas, and protected by the customs duties, the leather, tanning, saddlery, and shoe-making industries, were gradually established in the country. The cigarette factories, which are protected by high import duties, are in a very flourishing condition. There are several of these factories, the most important one buys its tobacco in the leaf, partly from Cuba, and partly from Capadore, Maturin, and Guanape, all in Venezuela. There are two chocolate factories of some importance at Caracas, and supply the local demand. There are two breweries, one of which produces from 10,000 to 12,000 hectolitres of beer annually (220,000 to 264,000 gallons). The hops come from Germany and Austria, and the bottles and corks from Germany. Two telephone companies are established in Caracas, only one of which, however, is said to be of importance, the Anglo-American Telephonic and Electrical Appliances Company. The company has a double system, one for the city of Caracas, and the other for certain points in the interior—Santa Lucia, Valencia, and the ports of La Guayra, and Puerto Cabello.

*THE ORIGIN OF THE BROOCH.**

The author suggests, as the prototype of the ring-and-pin contrivance for fastening a cloak, the use, by a hunting people, of the mammalian *Os innonominatum* and *Os calcis*, the corners of the cloak being drawn through the oval perforation of the former and then pierced by the sharp point of the latter. In this position the prominences on the *Os calcis* would drop into the hollow of the *Os innominatum* and prevent the *Os calcis* from falling out of place. The author notes, further, that very many rings of early date and various materials—bone, jet, shell, bronze, and iron—which are usually described as "armlets" are of too small diameter to allow the entrance even

* Abstract of a paper by Mr. Edward Lovett, read before the Anthropological Section of the British Association, at Southport, 1903.

of an infant's hand. As such rings are frequently found associated with pins of similar materials, commonly regarded as "hair pins," and as ring and pin are sometimes found *in situ* on the breast of a skeleton, it is inferred that they represent a simple ring-and-pin fastening of the kind described above. An apron-fastener of this type, composed of an iron ring and a horse-shoe nail, is still worn in some of the blacksmiths' shops in Scotland.

The next step of development is taken when the pin is perforated at the thick end and attached to the ring by a fibre to prevent it from being lost. This stage is actually represented by a ring-and-pin fastening which is in common use in China: the ring is of agate, and the pin, which is of silver, is attached to it by a silken thread. Probably many of the perforated pins in our museums were similarly attached to rings. An apron-fastener of the simple ring-and-pin type, composed of an iron ring and a horse-shoe nail, is still worn in some of the blacksmiths' shops in Scotland; a similar simple brooch is still worn by the shepherds of Perthshire and by the tinkers in many parts of Scotland; and another similar form was in very common use in Donegal as late as 1860.

A further step is taken when the pin itself is hinged upon the ring, for security, by bending its flattened head round the ring. This form is abundant in Celtic times. The Tara brooch is a striking example, though the author suggests that it may be a symbolic reversion to an earlier type. The inconvenience which accompanies the use of the ring-and-pin brooch, that the fabric to be fastened must be drawn far through the ring before the pin can pierce it, was remedied, it is suggested, by leaving a gap in the ring; and from this results the "penannular" brooch with its many varieties.

Correspondence.

NEW PORTS FOR INDIA.

No more fitting memorial of our much-regretted friend, Horace Bell, could have been devised than the publication in the *Journal* (July 1st, pp. 702-6) of the copious notes he left on "The Ports and Harbours of Peninsular (*i.e.* southern) India." In those notes indications were given of new harbours that could be constructed, and are urgently required on, say, half-a-score unutilised indentations on the three thousand miles of coast line of the Indian Empire. Now the question is, how can Mr. Bell's valuable suggestions be turned to account? Who will amplify and give practical definitive effect to the fresh start he gave in this long neglected branch of Indian public works? So far, only one response has appeared in the *Journal*, that by Mr. Dumayne, a Commissioner of the Port of Calcutta (August 18th, p. 806), describing facilities now made available for the handling of large modern steamers on the ever difficult Hughli. Also the Bombay Port Trust has recently formulated its attractive project for another dock system at that grand open gate of Eastern India.

But it must be noted that these improvements of existing inlets rather tend to lead attention away from Mr. Bell's far more comprehensive and productive design. That is, to provide more numerous and more generally distributed avenues for the sea-borne commerce of India, which, to the mind's eye of the instructed engineer, is capable of incalculable expansion. In large matters of this kind the good is often foe of the better.

The improvements and accommodation of interests connected with the existing three, or, say, four Indian harbours worthy of the name in the modern sense, tend to push back that larger development on which Mr. Bell was intent. The fourth port, which he did not happen to include in his unfinished notes, is that of Marmugao; though in that case the *hinterland* is the difficulty—one that will have to be borne in mind by the writer of the final and complete paper, for which the Society and India are waiting.

As regards natural difficulties to be contended with, Mr. Bell remarked:—"The comparatively small tidal range renders it no easy matter to select new sites." Had he lived to work out his survey he would, no doubt, have found there is at least one large exception to this condition, namely, the Gulfs of Cambay and Kutch. The writer who may carry forward his uncompleted task will find that the high range of tides in those waters—30 or 40 feet at least—afford ample scope for docks or deep-water harbours suitable for modern ocean-going vessels. If the basin of the Narbada, below Broach, could not be adapted because of the monsoon floods, there is, just to the north of that river's mouth, a natural basin at Dejhara which the marine engineer would know how to turn to account: and on the opposite Kathiawar coast, at or near Gogo, the high tidal range is all that can be desired in that respect. Then on the other side of that province, at or near Seraya on the Navanagar coast, is a capacious natural harbour that might well form the basis for an extensive system of inland water transit.

This reminds one that new ports or harbours on the coasts of India would need to be supplemented, wherever practicable, with canals for inland navigation. By the time half the water storage and irrigation projects formulated by the Scott-Moncrieff Commission are brought into working order, the question of economical transport of produce would have to be dealt with. Railways will not suffice as to capacity; and the cost in rates would, for long distances, be prohibitive. You must "put your burden on the water."

W. Martin Wood.

Weybridge, Nov. 2nd.

Obituary.

Samson Fox.—Mr. Samson Fox, who died of blood poisoning on Saturday, 24th ult., at the age of 65, was a member of the Society of Arts since 1879, and in 1885 he received the Society's Howard Gold Medal for the invention of corrugated iron flues for steam boilers. This award was made in connection with his exhibits at the International Inventions Exhibition, South Kensington. Mr. Fox was the son of a Yorkshire weaver, and after following his father's occupation for a time, he was apprenticed to Messrs. Smith, Beacock, and Tannett at the Round Foundry in Water-lane, Leeds. He superintended the machinery sheds of the firm at the exhibition in London in 1862. When still a young man, under 30, Mr. Fox joined his brother and another partner in the business of Fox, Brother, and Refitt, at the Silver Cross Works, Leeds, the business being that of making special tools. In 1874, having previously embarked on the manufacture of iron, he started the business of the Leeds Forge Company, making boiler plates. He invented the machinery by which the flues for machine and stationary boiler purposes can be most effectually corrugated. Pressed steel frames and plates associated with railway rolling-stock also received his attention, and he took out in all some 150 patents relating to metallurgical and mechanical engineering processes. He was a munificent donor to the Royal College of Music, and in all presented £46,000 for the erection of the buildings of the institution at Kensington-gore, of which £1,000 was for the adornment of the vestibule. Mr. Fox served both Leeds and Harrogate in municipal life, and was mayor of Harrogate three years in succession, 1889-91.

Sir Charles Nicholson, Bart., "the first Australian baronet and that country's oldest statesman" died at Totteridge, Herts, on Sunday, the 8th inst., in the 94th year of his age. He was born 23rd November, 1808, and in 1833 he graduated as M.D. with high honours in the University of Edinburgh; in this same year he went to Australia, and after practising his profession there with distinction, became a partner in a sheep station. Having settled in the country, "he was," says *The Times*, "welcomed as a powerful helper in organising the great public institutions of the country." He was a member of the first Legislative Council of New South Wales, in 1844, and three times its Speaker, 1845–56. He was from 1854 to 1860 Chancellor of the University of Sydney, an institution in which he took the greatest interest. He presented to the University a series of Egyptian antiquities, which he had himself collected in Egypt. He was knighted in 1852, and created a baronet in 1859. In 1865 Sir Charles Nicholson was elected a member of the Society, in 1876 he was a member of the Council, and on several occasions he presided at meetings connected with Colonial affairs.

MEETINGS FOR THE ENSUING WEEK.

Monday, Nov. 16...British Architects, 9, Conduit-street, W., 8 p.m. Monsieur J. T. Homolle, "Le Trésor de Cnide et les Monuments de l'Art Ionien à Delphes."

London Institution, Finsbury circus, E.C., 5 p.m., Dr. A. Hill, "The Brains and Minds of Animals."

Tuesday, Nov. 17...Designers, Clifford's-inn, Fleet-street, E.C., 8 p.m., Mr. Hugh Stannus, "Ancient Architecture in Egypt."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Adjourned Discussion on paper, by Prof. W. C. Unwin, "Tensile Tests of Mild Steel, and the Relation of Elongation to the size of the Test-Bar."

Statistical (at the House of the Society of Arts), John-street, Adelphi, W.C., 5½ p.m. Opening Address, by Major Patrick George Craigie.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. F. R. Beddard, "Note upon the Tongue and Windpipe of the American Vultures, with Remarks on the Inter-relations of the Genera *Sarcorhamphus*, *Gypagus*, and *Cathartes*." 2. Miss Dorothy M. A. Bate, "The Mammals of Cyprus." 3. G. A. Boulenger, "Report on the Fishes collected by Mr. Oscar Neumann and Baron Carlo von Erlanger in Gallaland and Southern Ethiopia."

Wednesday, Nov. 18...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Opening Meeting of the 150th Session. Inaugural Address by Sir William Abney, Chairman of the Council.

Meteorological, 25, Great George-street, S.W., 7½ p.m. Dr. Hugh Robert Mill and Mr. R. G. K. Lempfert, "The Great Dustfall of February 21st and 22nd, 1903, and its Origin."

Chemical, Burlington-house, W., 8 p.m. 1. Messrs. P. Remfrey and J. F. Thorpe, "Constitution of Ethel Cyanacetate." 2. Mr. W. T. Cooke, "The Action of Water and Dilute Caustic Soda Solutions on Crystalline and Amorphous Arsenic." 3. Mr. A. F. Girvan, "The Union of Carbon Monoxide and Oxygen." 4. Mr. G. G. Henderson, "Note on a Double Chloride of Molybdenum and Potassium." 5. Dr. W. H. Perkin, sen., "Simplification of Zeisel's Method for the Determination of Methoxy- and Othoxy- Groups." 6. M. S. Ruhemann, "The Action of Benzamidine on Olefine β-diketones."

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Prof. J. D. Everett, "Microscopic Resolution." 2. Mr. Walter Wesché, "The Mouth parts in the Nemocera."

United Service Institution, Whitehall, S.W., 3½ p.m. Mr. Alfred Mansell, "Our Food Supply in time of War."

Thursday, Nov. 19...Linnean, Burlington-house, W., 8 p.m. 1. Dr. Maxwell T. Masters, "A General View of the Genus Pinus." 2. Misses M. Benson and Elizabeth Sanday, "Contributions to the Embryology of the Amentifera;" Part II. *Carpinus Betulus*, Linn.

London Institution, Finsbury-circus, E.C., 6 p.m. Dr. W. H. S. Aubrey, "National and Patriotic Songs."

Friday, Nov. 20...Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. "Caricature."

Architectural Association, 9, Conduit-street, W., 7½ p.m. Mr. H. M. Cautley, "Farm Buildings."

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. 1. Mr. R. H. Fowler, "Roofing Existing Shops while work is proceeding." 2. Dr. Thomas E. Stanton, "Experiments on the Efficiency of Centrifugal Pumps."

CONTRIBUTIONS TO THE READING-ROOM.

The Council have to acknowledge, with thanks to the Proprietors, the receipt of Transactions of Societies and other Periodicals.

TRANSACTIONS, &c.

African Society, Journal.
American Academy of Arts and Sciences, Proceedings.
American Academy of Political and Social Science, Annals.
American Chemical Society, Journal.
American Institute of Architects, Bulletin.
American Institute of Electrical Engineers, Transactions.
American Philosophical Society, Proceedings and Transactions.
American Society of Civil Engineers, Proceedings.
American Society of Mechanical Engineers, Transactions.
Architectural Association, Notes.
Association of Engineering Societies (American), Journal.
Australasian Association for the Advancement of Science, Report.
Bath and West of England Society, Journal.
British Association for the Advancement of Science, Report.
British Dental Association, Journal.
British Fire Prevention Committee, Publications.
British Horological Institute, Horological Journal.
Brussels, Société d'Etudes Coloniales, Bulletin.
———, Travaux Publics de Belgique, Annales.
Camera Club, Journal.
Canada, Royal Society, Proceedings and Transactions.
Canadian Institute, Transactions.
Canadian Patent Office, Record.
Canadian Society of Civil Engineers, Transactions.
Central Chamber of Agriculture, Proceedings.
Chemical Society, Journal.
Chicago, Western Society of Engineers, Journal.
———, Field Columbian Museum, Publications.
Civil and Mechanical Engineers' Society, Transactions.
Cleveland Institution of Engineers, Proceedings.
Cold Storage and Ice Association, Proceedings.
Cornell University, Physical Review.
East India Association, Journal.
Farmers' Club, Journal.
Franklin Institute, Journal.
Geneva, Société des Arts, Bulletin de la Classe d'Industrie et de Commerce.
Geological Society, Quarterly Journal.
Glasgow Philosophical Society, Proceedings.
Haarlem, Koloniaal Museum, Bulletin.
Imperial Department of Agriculture for the West Indies, Publications.
India, Geological Survey, Memoirs, and Palæontologia Indica.
———, Government of, Agricultural Ledger.
Indian Meteorological Department, Report.
Institute of Actuaries, Journal.
Institute of Bankers, Journal.
Institute of Chemistry, Proceedings.
Institution of Civil Engineers, Minutes of Proceedings.
Institution of Electrical Engineers, Journal.
Institution of Engineers and Shipbuilders in Scotland, Transactions.
Institution of Gas Engineers, Transactions.
Institution of Junior Engineers, Record of Transactions.
Institution of Mechanical Engineers, Proceedings.
Institution of Mining and Metallurgy, Transactions.
Institution of Naval Architects, Transactions.
Iron and Steel Institute, Journal.
Japan, College of Science, Imperial University, Journal.
Japan Society, Transactions and Proceedings.
Kew Gardens Bulletin.
Linnæan Society, Journal.
Liverpool Engineering Society, Proceedings.
Liverpool Literary and Philosophical Society, Proceedings.
London Chamber of Commerce, Journal.
Manchester Literary and Philosophical Society, Memoirs and Proceedings.
Manchester Steam Users' Association, Reports.
Munich, Polytechnischen - Verein, Bayerisches Industrie-und-Gewerbeblatt.
National Association for the Promotion of Technical and Secondary Education, "Record."
National Indian Association, "The Indian Magazine and Review."
New South Wales, Royal Society, Journal and Proceedings.
New York Academy of Sciences, Annals and Memoirs.
North-East Coast Institution of Engineers and Shipbuilders, Transactions.
Nova Scotian Institute of Science, Transactions.
Paris, Comité International des Poids et Mesures. Procès Verbaux.
——, Conservatoire National des Arts et Métiers, Annales.

Paris, Société d'Encouragement pour l'Industrie Nationale, Bulletin.
——, Société de Geographie Commerciale, Bulletin.
——, Société Internationale des Electriciens, Bulletin.
——, Société Nationale d'Acclimatation de France, Bulletin.
Patent Agents, Chartered Institute of, Transactions.
Patent-office, Illustrated Official Journal.
Pennsylvania (Western), Engineers' Society of, Proceedings.
Pharmaceutical Society, "The Pharmaceutical Journal."
Philadelphia, Academy of Natural Sciences, Proceedings.
————, Engineers' Club, Proceedings.
Physical Society, Proceedings.
Quekett Microscopical Club, Journal.
Rome, Associazione Elettrotecnica Italiana, Atti.
Royal Agricultural Society, Journal.
Royal Asiatic Society, Journal.
Royal Astronomical Society, Memoirs.
Royal Colonial Institute, Proceedings.
Royal Cornwall Polytechnic Society, Annual Report.
Royal Geographical Society, "The Geographical Journal."
Royal Horticultural Society, Journal.
Royal Institute of British Architects, Journal.
Royal Institution of Cornwall, Journal.
Royal Institution of Great Britain, Proceedings.
Royal Irish Academy, Transactions and Proceedings.
Royal Meteorological Society, Quarterly Journal and Record.
Royal National Life Boat Institution, "The Life Boat" and Annual Report.
Royal Photographic Society of Great Britain, "The Photographic Journal."
Royal Scottish Society of Arts, Transactions.
Royal Society, Philosophical Transactions and Proceedings.
Royal Society of Edinburgh, Transactions and Proceedings.
Royal Statistical Society, Journal.
Royal United Service Institution, Journal.
Sanitary Institute, Journal.
Smithsonian Institution, Report and Publications.
Society of Antiquaries, Archæologia and Proceedings.
Society of Biblical Archæology, Proceedings.
Society of Chemical Industry, Journal.
Society of Dyers and Colourists, Journal.
Society of Engineers, Transactions.
Society of Public Analysts, "The Analyst."
South Wales Institute of Engineers, Proceedings.
Victoria Institute, Journal of the Transactions.

JOURNALS.

Weekly.

Amateur Photographer.
American Architect and Building News.
American Gas Light Journal.
American Machinist.
Architect.
Athenæum.
Automobile Club Journal.
Automotor.
Board of Trade Journal.
Bradstreet's.
British Architect.
British Journal of Photography.
Builder.
Building News.
Chemical News.
Chemist and Druggist.
Colliery Guardian.
Cosmos: Revue des Sciences.
Draper.
Economist.
Electrical Engineer.
Electrical Review.
Electrical Times.
Electrician.
Electricien (Paris).
Electricity.
Engineer.
Engineering.
Engineering News (New York).
Engineering Record (New York).
English Mechanic.
Gardeners' Chronicle.
Gardening World.
Herapath's Railway Journal.
Iron and Coal Trades Review.
Ironmonger.
Journal of Gas Lighting.
Lancet.
Land and Water.
Mechanical Engineer.
Medical Press and Circular.
Millers' Gazette.
Mining Journal.
Moniteur Industriel.
Musical Standard.
Nature.
Notes and Queries.
Oils, Colours, and Drysalteries
Photographic News.
Photography.
Practical Engineer.
Produce Markets' Review.
Public Health Engineer.
Publishers' Circular.
Queen.
Revue Industrielle.
Sanitary Record.
Saturday Review.
Science.
Scientific American.
Shipping World.
Spectator.
Surveyor.
Textile Mercury

Fortnightly.

Agricultural News (Barbados).
Corps Gras Industriels.
Country Brewers' Gazette.
Finance Chronicle.
Irish Builder.
Jeweller and Metalworker.
Madrid Cientifico.
Perak Government Gazette.
Quinzaine Coloniale.
Railways (Calcutta).
Revue des Cultures Coloniales.
Woodworker.

Monthly.

American Exporter (New York).
Architectural Review.
Arms and Explosives.
Bookseller.
Brewers' Guardian.
Brewers' Journal.
British Inventor.
British Trade Journal.
Building Societies' Gazette.
Burlington Magazine.
Cabinet Maker and Art Furnisher.
Caterer and Refreshment Contractors' Gazette.
Chronique Industrielle.
Coach Builders' and Wheelwrights' Art Journal.
Cold Storage and Ice Trades Review.
Dyer and Calico Printer.
Educational Times.
Electro Chemist and Metallurgist.
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